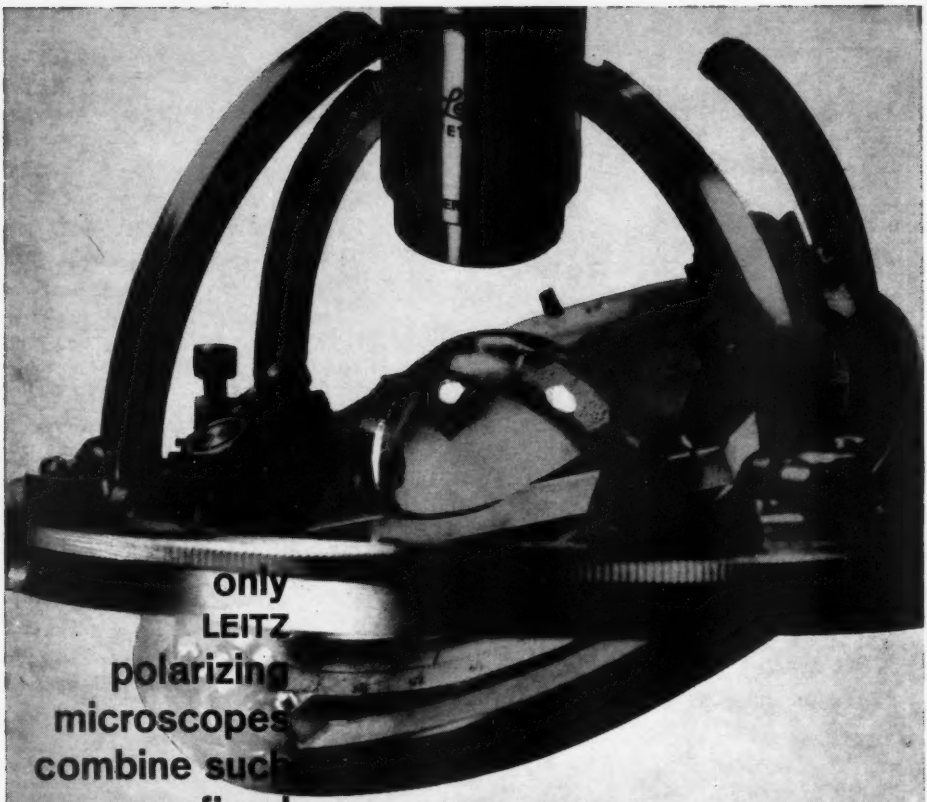
GeoTimes

Professional News Magazine

September 1961

Vol. VI, No. 2

Published by the
American Geological Institute



only LEITZ polarizing microscopes combine such refined precision and limitless versatility

4 specialized Polarizing Microscopes for advanced research, laboratory and student

DIALUX-POL... the world's most advanced universal polarizing research microscope. A choice of more than 100 optional interchangeable components permits almost infinitely varied combinations for precision measurement, examination and photomicrography that require polarizing techniques. Features a built-in light source and matching condenser system. Adapts for transmitted or reflected polarized light.

Exclusive Optional Features: conoscopic observation with binocular body • single-knob coarse and fine adjustment • monocular tube with iris diaphragm for small crystal identification • combination FS tube for photography • vertical illuminator for ore microscopy • choice of polarizing filters or calcite prisms.

ORTHOLUX-POL... world's widest range universal research microscope for all types of microscopy in addition to polarizing features. Built-in system for incident and transmitted illumination, including incident phase contrast.

LABOLUX-POL... laboratory and semi-research polarizing microscope with built-in transmitted illumination and provisions for work in incident light.

SM-POL... student polarizing microscope or chemical microscope for general applications in transmitted polarized light.

ARISTOPHOT PHOTOGRAPHIC UNIT... supplements Leitz polarizing microscopes for photomicrography, macrophotography and low-power surveys with incident or transmitted light. Mirror reflex system for 3¼ x 4¼ (9 x 12cm), 4 x 5 or Polaroid; also adapts to Leica 35mm.

Yours for the asking... **FREE** — Complete 62-Page Manual of Leitz specialized polarizing microscopes, accessories and photomicrography units. Includes detailed bibliography on all applications. Dept. GT-9

30481

E. LEITZ, INC., 468 PARK AVENUE SOUTH, NEW YORK 16, N. Y.
Distributors of the world-famous products of Ernst Leitz G. m. b. H., Wetzlar, Germany—Ernst Leitz Canada Ltd.
LEICA AND LEICINA CAMERAS · LENSES · PROJECTORS · MICROSCOPES

Calendar

Cooperation of Society Secretaries in supplying meeting notices for GEOTIMES calendar is requested.

September, 1961 — INTERNAT. PALEONTOLOGICAL UNION/MEDITERRANEAN NEOCENE COMMITTEE, Meeting, Sabadell, Spain. Write: J. Roger, Serv. d'Information Geol. du B.R.G.M., 74, rue de la Federation Paris 15.

Sept. 3-8, 1961—AMER. CHEM. SOC., 140th meeting, Chicago, Ill.

*Sept. 7-9, 1961 — ALBERTA SOC. PETROL. GEOL. & GEOL. ASSOC. CANADA, jointly sponsored convention and field trip, Calgary. Theme—Canadian Sedimentary Basins. Papers 2 days, trip 1 day. Write: J. S. Crewson, 401 Natural Gas Bldg., Calgary, Alta., Canada.

Sept. 17-20, 1961—AIME: Minerals Beneficiation Div., Denver, Colo.

Sept. 18-23—III INTERNAT. CONGRESS OF SPELEOLOGY, Vienna, with excursions before and after the meetings. Write: Generalsekretariat des 3. Internationalen Kongresses für Speläologie, Verband österreichischer Höhlenforscher, Wien II, Obere Donaustrasse 99/7/3.

Sept. 25-30, 1961 — INTERNAT. CONF. ON MAGNETISM AND CRYSTALLOGRAPHY, Kyoto Kaikan Assembly Center, Kyoto, Japan. Write: Organizing Comm., Science Council of Japan, Ueno Park, Tokyo, Japan.

Sept. 28-29, 1961—INTERNAT. GEOPHYSICS ASSOC., Colloquium, Salzburg. Write: the Assoc., Freisaalgasse 31, Salzburg, Austria.

Oct. (9-10 days) 1961—SYMPOSIUM ON THE FORMATION OF IGNIMBRITES, HYALOCLASTITES AND RELATED DEPOSITS, Catania, Sicily. Write: Prof. A. Rittmann, Pres., Internat. Assoc. of Volcanology, c/o Dept. of Volcanology, Catania Univ., Catania, Sicily.

Oct. 2-3, 1961—AIME & CIMM: Joint Meeting, Ind. Minerals, Ottawa, Ont., Canada

Oct. 2-7, 1961 — UNESCO-WMO SYMPOSIUM ON CHANGES OF CLIMATE, with special reference to the Arid Zones, FAO Headquarters, Rome. Write: UNESCO, Dept. of Nat. Sci.

Oct. 4-6, 1961—ASP: Semi-annual Convention, New York City

Oct. 8-11, 1961—AIME: Soc. of Petr. Engrs., Fall meeting, Dallas, Texas.

Oct. 9-10, 1961—ACerS: Basic Science Division, Schenectady, N. Y.

Oct. 9-12, 1961 — SYMPOSIUM ON RECENT DEVELOPMENTS IN RESEARCH METHODS AND INSTRUMENTATION, Nat. Inst. of Health, Bethesda, Md. Write: James B. Davis, N.I.H., Bethesda 14, Md.

Oct. 13-15, 1961—CALIF. ASSOC. ENGR. GEOLOGISTS, 4th Ann. Meeting, Hotel Senator, Sacramento, Calif. Papers, 1 Symposium, Field trip, 1 day each. Write: W. W. Peak, P. O. Box 4164, Sacramento 21, Calif.

Oct. 13-20, 1961—INTERNAT. ASSOC. OF SCIENTIFIC HYDROLOGY, symposium on Methods of Evaluating resources of Underground Water with Emphasis on Arid Zone Problems, Athens. Write: the Assoc., 61, rue des Ronces, Gentbrugge, Belgium.

*Oct. 14-18, 1961—NATIONAL CLAY CONF., Univ. of Texas, Austin. Field trip Oct. 14 to bentonite localities of Texas Gulf Coast and vermiculite field trip Oct. 15. Write: E. Joseph Weiss re program or papers and Stephen E. Clabaugh re field trips, both at Univ. of Texas.

Oct. 16-20, 1961—AMER. SOC. OF CIVIL ENGINEERS, Ann. Convention, New York City

Oct. 18-20, 1961—OPTICAL SOC. OF AMER., Ann. Meeting, Los Angeles, Calif.

Oct. 18-21, 1961—AAPG: Mid-Cont. Regional meeting, Amarillo, Texas.

Oct. 25-27, 1961—GULF COAST ASSOC. OF GEOL. SOC's., meeting, Granada Hotel, San Antonio, Tex.

Oct. 30-Nov. 1, 1961—SOC. OF RHEOLOGY, 32nd Ann. Meeting, Madison, Wisc.

Oct. 30-Nov. 1, 1961—SVP: Ann. Meeting, Chicago Nat. Hist. Mus., Chicago.

Oct. or Nov. 1961 — INTERNAT. MINING CONVENTION, El Paso, Texas. Write: M. Hopper, 310 San Francisco St., El Paso.

*Nov. 1-3, 1961—SOUTHWESTERN FED. OF GEOL. SOC'S., Ann. Meeting. El Paso, Tex. Trip into northern Chihuahua, Mex. to study geol. of the area. Write: Texas Western Coll., Geol. Dept., El Paso.

Nov. 2-3, 1961—AIME: Soc. of Petr. Engrs., 32nd Ann. California regional meeting, Los Angeles, Calif.

*Nov. 2-4. 1961—GSA: Ann. Meeting, Cincinnati, Ohio. Nine trips through area around Cincinnati to study Paleozoic stratig. and struct.; Write: Ralph J. Bernhagen, Ohio Geol. Surv., Ohio State Univ., Columbus 10. re trips. Guidebooks.

Nov. 2-4, 1961—SEcG, MSA, PALEO. SOC. & GEOCHEM. SOC., meeting jointly with GSA, Cincinnati, Ohio

Nov. 5-9. 1961—SEGp: 31st Ann. Internat. Meeting, Hilton Hotel, Denver, Colo. Write: R. C. Holmer, 516 Acoma St., Denver 4, Colo.

Nov. 8-11, 1961—AMER. METEOR. SOC., 4th Conf. on Applied Meteorology, Atlanta, Ga.

Nov. 9-11, 1961—15th Canadian Soil Mechanics Conf., Montreal, Que., Canada

Nov. 13-15, 1961—A.P.I.: Ann. Meeting, Chicago.

Nov. 15-17, 1961—EASTERN ANALYTICAL SYMPOSIUM, Hotel Statler Hilton, New York City.

Dec. 26-31, 1961—AAAS: Ann. Meeting, Denver, Colorado.

*Dec. 7-9, 1961—NAGT, Texas Sect., & Texas Acad. of Sci., Joint Ann. Meetings, and half day trip through Gulf Coastal area on Dec. 9. Write: J. W. Dixon, Dept. Geol., Baylor Univ., Waco, Texas.

1962

Jan. 8-12, 1962 — HIGHWAY RESEARCH BOARD, Ann. Meeting, Sheraton-Park Hotel, Washington, D.C.

Feb. 7-9, 1962—CANADIAN INST. OF SURV. & PHOTOGRAM., Ann. Meeting, Ottawa, Ont., Canada.

Feb. 18-22, 1962—AIME: Ann. Meeting, New York City.

Mar. 11-17, 1962—ACSM-ASP: Ann. Meeting, Shoreham Hotel, Washington, D. C.

Mar. 15-17, 1962—OPTICAL SOC. OF AMERICA, Meeting, Washington, D. C.

Mar. 20-29, 1962—AMER. CHEM. SOC.: 141st Meeting, Washington, D. C.

Mar. 26-29, 1962—AAPG-SEPM: 47th Ann. Meeting, Civic Auditorium hdqtrs., Hdqtrs. Hotel, Fairmont Hotel, San Francisco, Calif.

April 13-14, 1962—IOWA ACAD. OF SCI., Ann. Meeting. Write: Paul F. Romberg, Iowa State Univ., Ames, Iowa.

*April 16-21, 1962—INTERNAT. MINERALOGICAL ASSOC., 3rd Congress, Washington, D.C. Field trips April 14-16 & 21-23. Write: Miss Marjorie Hooker, U. S. Geological Survey, Washington 25, D. C.

April 22-25, 1962—ASSOC. OF AMER. GEOGRAPHERS, 58th Ann. Meeting, Miami Beach, Florida

April 23-25, 1962—AAPG: Rocky Mountain Sect., Salt Lake City, Utah.

April 23-25, 1962—CIM: Annual General Meeting, Chateau Laurier, Ottawa, Ont., Canada.

April 23-28, 1962—INTERNAT. CONF. ON PALYNOLOGY, Tucson, Ariz. Write: Palyn. Conf. Planning Comm., Geochronology Labs., Univ. of Arizona, Tucson.

*April 26-May 3, 1962 — JUBILEE CONVENTION, Royal Geol. & Mining Soc. of the Netherlands and Geol. Survey of the Netherlands, The Hague. Theme: Geology and Mining in the Netherlands. Field trips May 2 and 3. Write: Secretariat of the Jubilee Convention, 14, Burgemeester de Monchyplein, The Hague.

April 29-May 3, 1962—ACerS: 64th Ann. Meeting, New York City.

May 2-4, 1962—COUNCIL OF ENGINEERING SOCIETY SECRETARIES, Royal York Hotel, Toronto, Ont., Canada.

May 7-8, 1962—AIME: Soc. of Petroleum Engrs., 5th Biennial Secondary Recovery Symposium, Wichita Falls, Texas.

May 8-?—7th INTERNAT. HYDROGRAPHIC CONF., Monte Carlo, Monaco. Write: Internat. Hydr. Bur., Quai des Etats-Unis, Monte Carlo.

May 24-25, 1962 — AIME: Soc. of Petroleum Engrs., Ann. Joint Meeting, Rocky Mountain Petroleum Sect's., Billings, Mont.

*May 9-19, 1962—SYMPOSIUM ON THE PREDICTION OF TIME AND PLACE OF VOLCANIC ERUPTIONS and the relationship between magmas and the nature of volcanic eruptions, Tokyo. Field trips during and after the Symposium period. Write: Secretary, Organizing Committee, International Symposium on Volcanology, Science Council of Japan, Ueno Park, Tokyo, Japan

June 4-7, 1962—SEVENTH NUCLEAR CONGRESS, New York City. Write: E.J.C., 29 W. 39th St., New York 18.

July 9-14, 1962—INTERNAT. CONGRESS ON GLASS, 6th, Washington, D. C. Write: C. H. Hahner, Internat. Comm. on Glass, c/o Glass Section, Nat. Bur. of Standards, Washington 25, D. C.

July 24-27, 1962 — INTERNAT. UNION OF CRYSTALLOGRAPHY, Symposium in commemoration of the 50th Anniversary of the Discovery of X-Ray Diffraction and of Crystal-Structure Analysis, Munich, Germany

Sept. 9-14, 1962—AMER. CHEM. SOC.: 142nd Meeting, Atlantic City, N.J.

Sept. 17-20, 1962—SEGp: 32nd Ann. Internat. Meeting, Calgary, Alta., Canada.

Oct. 3-5, 1962 (tentative) — SOUTHWESTERN FED. OF GEOL. SOC's., Ann. Meeting, Dallas, Tex.

Oct. 7-10, 1962 — AIME: Soc. of Petroleum Engrs., Fall Meeting, Los Angeles, Calif.

Oct. 31-Nov. 3, 1962—GULF COAST ASSOC. OF GEOL. SOC's., New Orleans, La.

Nov. 5-9, 1962—THIRD WORLD METALLURGICAL CONG., Chicago, Ill. Write: Chester Wells, ASM, 7301 Euclid Ave., Cleveland 3, O.

Nov. 12-14, 1962—GSA: Annual Meeting, Houston, Tex.

Nov. 12-14, 1962—A.P.I., Ann. Meeting, Chicago.

Dec. 26-31, 1962—AAAS: Ann. Meeting, Boston, Mass. (tentative).

1961 SCHEDULE OF FIELD TRIPS

For additional field trips held in conjunction with meetings, see those items marked with an asterisk under meeting calendar.

Sept. 7-8—ROCKY MOUNTAIN ASSOC. OF GEOLOGISTS, field conf. to study pre-Pennsylvanian section in Salida, Monarch, Ouray, Silverton and Durango areas. Technical session in Salida night of Sept. 6. Write: Conf. chairman D. W. Bergman, 315 Colorado Bldg., Denver, Colo. Guidebook.

Sept. 7-9—ALBERTA SOC. PETROL. GEOL., trip to Turner Valley, Savannah Creek and Kananaskis Lakes, southwest Calgary foothills and mountains to study mountain structures and Paleozoic and Mesozoic stratig. Write: H. G. Gammell, 528 9th Ave., W., Calgary, Alta. Guidebook.

Sept. 14-16—KANSAS GEOL. SOC., 26th Ann. Field Conf., Mark Twain Hotel, Hannibal, Mo. Trip to Mississippi R. Valley between St. Louis and Hannibal to study boundary problems of lower Miss. section. Write: Orvie L. Howell, c/o Lario Oil & Gas Co., 301 So. Market, Wichita, Kans.

Oct. 5-8—NEW MEXICO GEOL. SOC., trip to Sandia Mtns., Hagan Basin, Jemez Mtns. in SE San Juan Basin and Lucero Uplift to study geology of Albuquerque area. Write: Charles Reed, USGS, Box 4083, Albuquerque. Guidebook.

Oct. 6-8—ATLANTIC COASTAL PLAIN GEOL. ASSOC., 2nd Ann. Field Conf. Trip to Cretac. and Tert. localities in N. J., Del. and Md. Write: H. G. Richards, Acad. of Nat. Sci., 19th & Parkway, Phila. 3, Pa.

Oct. 7—UTAH GEOL. SOC., trip to Bingham mining district and adjacent Oquirrh Mtns. to study stratig. and struct. of district and mountains. Write: Douglas R. Cook, 1935 S. Main St., Salt Lake City. Guidebook.

Oct. 13-15—NEW ENGLAND INTERCOLL. GEOL. CONF., trip to Green Mountain and eastern highlands of Conn. Valley to study glacial geology in central and west, economics of talc, asbestos and granite and structure in N. part of state. Write: C. G. Doll, East Hall, Univ. Vermont, Burlington, Vt.

Oct. 14-15—TRI-STATE FIELD CONF., of Iowa, Ill. and Wisc.; trip to SW Ill. to study probably lower Penn. and upper Miss. strat. and sedimentation. Write: S. E. Harris, Jr., Geol. Dept., So. Ill. Univ., Carbondale, Ill.

Oct. 18-21—WEST TEXAS GEOL. SOC., trip to Coke, Nolan, Fisher and Stonewall Co's. Texas to study Permian stratig. and oil fields of the area. Write: Martin L. Johnson, Box 1540, Midland, Texas. Guidebook.

October—ASSOC. OF MISSOURI GEOL., trip to St. Francois Mtns. of Ozark Uplift to study Precambrian and engineering geology. Write: W. C. Hayes, Mo. Geol. Surv., Box 250, Rolla, Mo. Guidebook.

FIELD TRIP CALENDAR

Most of the information regarding field trips in this calendar appears through the courtesy and cooperation of the AAPG Field Trip Committee. Corrections, additions and new trip notices should be sent to Edward E. Rue, AAPG Field Trip Committee, 216-19 King City Building, Mount Vernon, Ill., with a carbon copy to GeoTimes Calendar, American Geological Institute, 2101 Constitution Ave., N.W., Washington 25, D.C.

This Month in GEOTIMES

Professional News Magazine

Published by **THE AMERICAN GEOLOGICAL INSTITUTE**

Robert C. Stephenson, EDITOR

Kathryn Lohman, CIRCULATION MANAGER

VOL. VI, No. 2 Sept. 1961

Page

Tektites: A World-Wide Geological Investigation
by Virgil E. Barnes 8

The Goals of Project VELA
by Charles C. Bates 13

Antarctic Geologic Studies on Northern Palmer Peninsula
by Martin Halpern 17

Natural Resources of the U.S.S.R.
by Pyotr Y. Antropov 18

Language Barriers in Earth Science
by K. O. Emery and Bruce D. Martin 19

The Lunar Surface
by Roy G. Brereton 22

Data Sheet 27
by Robert R. Compton 29

AMERICAN GEOLOGICAL INSTITUTE

Executive Committee

PRESIDENT
Ian Campbell
VICE PRESIDENT
Gordon I. Atwater
PAST PRESIDENT
Raymond C. Moore
SECRETARY-TREASURER
Donald H. Dow
FINANCE CHAIRMAN
Michel T. Halbouty
NAS REPRESENTATIVE
Edward B. Espenshade, Jr.
EXECUTIVE DIRECTOR
Robert C. Stephenson

Member Societies

American Association of Petroleum Geologists
American Geophysical Union
American Institute of Mining Metallurgical and Petroleum Engineers
Association of American State Geologists
Geochemical Society
Geological Society of America
Mineralogical Society of America
National Association of Geology Teachers
Paleontological Society
Seismological Society of America
Society of Economic Geologists
Society of Economic Paleontologists and Mineralogists
Society of Vertebrate Paleontology

GEOTIMES is published eight times a year, January-February, March, April, May-June, July-August, September, October, November-December, by the American Geological Institute at Williams and Heintz Lithograph Division, Washington, D. C. Address all correspondence to 2101 Constitution Ave., N.W., Washington 25, D. C.

Subscriptions: GEOTIMES is distributed to members of supporting Member Societies as a part of their society membership. Non-member rates—U.S.A. and Possessions, Canada and Mexico, $2.00 per year; elsewhere, $2.50 per year. Single copy .35¢. Second class postage paid at Washington, D. C.

The American Geological Institute and its Member Societies assume no responsibility for statements and opinions advanced by contributors to GEOTIMES.

PROFESSIONAL INSTRUMENTS

. . . . from WARD'S

OUR 99TH YEAR

ALTITUDE BAROMETER by TAYLOR

Altitude Barometers. A necessary item in the working equipment of geologists. This precision instrument has a chrome-plated brass case with a 3" diameter dial. Supplied in a velvet-lined leather carrying case. Choice of three dial graduations:

C 2058.1	6,000 ft. in 20' divisions	**97.50**
C 2058.2	10,000 ft. in 50' divisions	**97.50**
C 2058.3	16,000 ft. in 50' divisions	**97.50**

RANGER COMPASS by SILVA

TYPE 15 RANGER

- Liquid Filled
- Sighting Mirror
- Transparent Protractor Plate
- Declination Offsetting Device
- Transparent Housing

Approved and used by professional people around the world. Truly a proficient instrument for foresters, geologists, surveyors, scientific explorers, sportsmen, and others demanding accuracy, speed, and utility. Many appraise this model as the world's best hand compass. Army model in several countries. Sighting mirror for speed and exactness. Built-in mechanism to adjust for magnetic declination. Transparent base plate and transparent housing for accurate bearings from a map or chart. Highly magnetized needle encased in liquid. Sapphire jewel bearing. Luminous points. Waterproof. Handy size and light weight. Dial graduated 0° to 360°. Engineer's scale in inches and tenths of an inch on one side of base plate. Millimeter scale on other side. Instructions. Size: 4" x 2½ x ¾". Weight: 3 oz.

C 2102	**14.95**
Leather case **C 2102.1**	**3.25**

ALL-METAL CONTACT GONIOMETER by WARD'S

C 3502 Ward's All-Metal Contact Goniometer. A durable, accurate contact goniometer has been needed for many years! Ward's now introduces a design that will hold up and can be a **permanent** instrument for every geologist and geology student! This new unit outperforms and outlasts former models made of cardboard and plastic. Quick, rapid method for accurate measurements of the angles of crystal specimens. Each individually packed in a sturdy manila envelope with instructions.

In stock for immediate shipment. Each	**1.50**
In lots of ten, each	**1.35**

NEW BROAD SPECTRUM LAMP by MINERAL EQUIPMENT

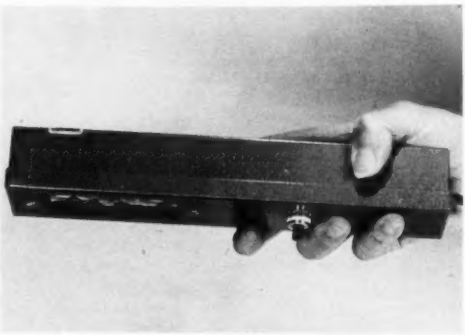
C 5634 Broad Spectrum Ultraviolet Lamp. This new exclusive light source puts out a full amount of brilliant short wave ultraviolet plus a copious amount of long wave ultraviolet at the same time! A new high in **combined** ultraviolet efficiency. Only **one** filter, **one** tube, **and one** push-button to operate!

The unit operates on ordinary house current. It is excellent for small school displays and for demonstration teaching where the intricacies of long and short wave need not be explained; these sometimes detract from the phenomenon of the principle of ultraviolet.

Also useful for field prospecting for tungsten, uranium, zirconium, ruby, and zinc. For field use it is used with the battery adapter unit.

This remarkable new lamp has an Alzak reflector and a Full-range filter for brilliance and coverage. Both filter and tube are rubber cushioned for protection from shock. Two coats of baked finish in durable, handsome, gray hammertone. Size 10" long x 2" wide x 1½" deep. Shipping weight, 3 lbs. **24.95 ea.**

C 5634.1	Replacement tube	**6.50 ea.**
C 5634.2	Replacement filter	**6.00 ea.**
C 5634.3	Battery Case complete with batteries, used for field operation of lamp	**12.95 ea.**



PLEASE NOTE: Prices do not include packing or shipping charges, which are additional at cost.

WARD'S NATURAL SCIENCE ESTABLISHMENT, INC.

P. O. BOX 1712 • ROCHESTER 3, NEW YORK

Today / Tomorrow

The AGI has started a new service for elementary and secondary school science teachers by initiating recently its GEOLOGY REFERENCE SERIES FOR SCIENCE TEACHERS. This is an open-end pamphlet series designed to organize and make available helpful information for science teachers at low cost. Three general categories of pamphlets are anticipated - - a. sources of information, b. classroom teaching aids, and c. laboratory and field projects. Three pamphlets have been issued in the series.

S-1. Sources of Geological Information
S-2. Selected References for Earth Science Courses
S-3. Films for Earth Science Courses

The pamphlets are available at a cost of $0.10 each (discounts in quantity) from Publications, American Geological Institute, 2101 Constitution Ave., N.W., Washington 25, D. C.

Mr. M. Thomas Rosser joins the AGI staff in September as Administrative Officer to take charge of business activities of the Institute. Tom Rosser is a graduate in accounting and a native of the Washington area. He comes to AGI from Gallant, Inc., Washington business firm.

The Specialties List used by scientists in completing forms for the National Register of Scientific and Technical Personnel is undergoing revision. AGI, as one of the eight participating scientific groups, maintains the Register for geology-solid earth geophysics and certain related areas. The AGI will conduct the revision of its portions of the specialties list through a series of conferences with specialistic scientific groups and other participating sciences. The AGI, through the revision, hopes to achieve two things: (1) produce a better balanced specialties check list and (2) provide a means for geological scientists engaged in applied science to better describe their specializations of application. The data resulting from the use of the revised questionnaire should make the analysis of the growth and development of the geosciences more meaningful.

A paperback abridged edition of the AGI Glossary of Geology and Related Sciences with Supplement (Howell, Weller and others, 2nd Edit., 1960) is in press. The paperback edition will contain about 7500 select terms and will be published in the Anchor Book Series of Doubleday & Co. The abridgement was completed by a task force team at Iowa State University. The abridged paperback edition is intended for secondary school science teachers of earth science, non-major college geology students and the lay public.

Many individual geologists and local and regional geological organizations were able to clip unanticipated dividend coupons resulting from one of AGI's education programs during past months. AGI Visiting International Scientists - Professors Brinkmann (Bonn), Gansser (Zurich), Goguel (Paris), Kuno (Tokyo) and Van Bemmelen (Utrech) lectured before professional societies on numerous occasions and spent many interesting hours in the field and laboratory with leading U. S. scientists.

NEW FEATURE

Complete, selected translations from Soviet Geology (Sovetskaya Geologiya) 1960, Nos. 1 thru 12 will soon be published in IGR* *in addition to the regular selected screening of Russian, Chinese, and Japanese geologic literature.* IGR* *rates to members of* AGI *member societies on the* GeoTimes *mailing list educational institutions—their personnel — $15 per year; all others $55 per year. Foreign postage $1.00 per year; PUAS countries 50¢ per year; no additional charge to Canada and Mexico.* IF *you do not now subscribe to* IGR* *send your order and payment to—*

International Geology Review

AMERICAN GEOLOGICAL INSTITUTE
2101 CONSTITUTION AVENUE, N.W.
WASHINGTON 25, D. C.

The Changing Image

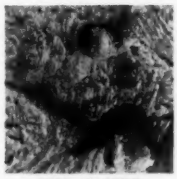
A summer rerun TV show told the story of a wealthy old lady who, by living in seclusion in the family mansion which had been stripped of mirrors, clung to the illusion that the ravishing beauty of her youth was timeless. Devoted servants played along with the dream world fantasy of their mistress. She eventually died without having to face the reality that her beauty had faded. A rather foolish plot, isn't it?

The post-war decade was the golden era of the exploration geologists and geophysicists. The field was so rich with opportunities that it was rapidly flooded with practitioners. Some went the full route of academic training to become trained geoscientists, while many other short circuited the attainment of depth of basic scientific knowledge to arrive more quickly at the pay-off window. As a matter of fact, many looked with disdain on those who chose to be the "scientific-type" at a time when there were so many economic opportunities to be realized. We, as a profession, were living high on the hog, and too large a proportion of the profession took on the characteristics of sleek, self-satisfied, fat cats.

All too suddenly, with a marked change in our raw material economy, this golden era of the exploration geologists and geophysicists came to an end. The rose colored glasses through which we had been admiring ourselves were lost. In the mirror we saw a profession which had failed in many instances to adequately develop and maintain its scientific capabilities. We saw that a significant segment had been more interested in the science of making money than in the science of geology. The mirror showed many tell-tale and not too pleasant signs of our high living.

One area of the mirrored image of the geological scientists, however, has recently grown pleasant to look at. A growing percentage of career scientists in geology are getting adequate academic background and these scientists are finding positions of challenge and responsibility. Among geologists and solid earth geophysicists, scientific geology has taken on a new aura of respectability. Employers as well as scientists appear to have a new appreciation of academic preparation and scientific background.

By examining ourselves in the mirror and doing something about what we have seen, a new image is developing which is more healthy to behold. This new image is that of a well-trained scientist interested in geology as a science.



OUR COVER

Vertical air photo of the two-mile diameter Brent Crater in Algonquin Park, near Brent, Ontario. *Photo by courtesy of Spartan Air Services, Ltd.*

The AMERICAN GEOLOGICAL INSTITUTE is a non-profit professional service organization established and managed by the scientific societies in the fields of geology and geophysics in cooperation with the National Academy of Sciences-National Research Council. It is the instrument of the profession serving and advancing the welfare of the geoscientist in matters relating to education, professional responsibilities and government relations. It is an active member of the Scientific Manpower Commission. It also functions in the stimulation of public education and awareness of the earth sciences, through career literature, the scouting program and other channels of communication.

GEOTIMES is the news magazine of the geological sciences. It reports on current events in the earth sciences, public education and public relations efforts throughout the profession, as well as appropriate legislative and governmental issues. It announces scholarships, fellowships, publications and new developments. It provides a forum for discussion of timely professional problems, and affords a common bond between the many specialized groups within the earth sciences.

A World-wide Geological Investigation of

TEKTITES

by VIRGIL E. BARNES [1]

In the maze of speculation, controversy, and facts involved in the question of the origin of tektites during the past 200 years no one had ever undertaken a systematic and coordinated field examination of localities where these and other natural glasses occur about the world. The writer believes that evidence derived from such an examination is basic to solving the puzzling problem of whether tektites are glassy meteorites or whether they originate from unusual catastrophic events on earth. With this in mind the writer submitted a proposal to the National Science Foundation for examination of tektite-strewn fields, meteorite craters, areas where other natural glasses occur, and for petrographic, mineralogic and chemical studies. The proposal included melting experiments to be performed by Dr. Earl Ingerson on the material collected. The project, approved for a two-year period from June 1, 1960, is administered by The University of Texas.

Following the International Geological Congress in Copenhagen in August, 1960, the writer [2] spent six months visiting most of the tektite-strewn fields, some meteorite craters with glass around them, tektite collections in museums, and workers on tektites and meteorites in England, Russia, Czechoslovakia, Egypt (UAR), Saudi Arabia, India, Malay, Singapore, Australia, Indonesia, Thailand, Cambodia, South Viet-Nam, and the Philippines. Because a six-month journey covering so many thousands of miles and so many experiences can not be dealt with in a few pages, areas which may be of most interest to the readers will be elaborated upon and others mentioned only briefly.

In Czechoslovakia the writer met scientists who have been out of contact with the west since World War II and found them eager to cooperate. Excellent collections of moldavites are in Prague and Budéjovice, and several field occurrences were visited near Budéjovice (Budweiss). All German names have been replaced—the Moldau River is now the Vltava and moldavites, which were named for the river, are now called vltaving by many Russians and Czechs.

In Cairo we examined and photographed the fine specimens of Libyan Desert glass in the Geological Museum.

Dhahran, Saudi Arabia, was the next stop, where the Arbian American Oil Company generously provided transportation to the al Hadida (Wabar) craters, first discovered by H. St. J. Philby in the Rub' al Khali in 1932. The Rub' al Khali (Empty Quarter) is one of the largest sand deserts in the world, covering an area of about 230,000 square miles. From Dhahran we flew to Ubailah, Aramco's desert operations base, and from there the trip to the craters was made in a Dodge Town Wagon and a Dodge Power Wagon, both with sand tires. Even so the Town Wagon, which had somewhat smaller tires, got stuck occasionally and had to be pulled out by the Power Wagon.

The dunes in this part of the desert are relatively low, ranging only up to about fifty feet in height, and it is possible to drive almost anywhere if the slip slopes of the dunes are avoided. Donald A. Holm, Aramco geologist, zeroed in on the craters 100 kilometers from Ubailah, guided only by what was left of Aramco's triangulation stations. Most had been felled by back-scratching camels.

We overran the only remaining crater, missing it by one sand dune to the north. The triangulation station on the crater rim was down but someone had left an oil drum on a dune, which Don Holm spotted and from which the crater could be seen. On the way to the oil drum we crossed a

[1] Director, Research on Tektites, The University of Texas, Austin.

[2] Accompanied by Mrs. Barnes who served as secretary and interpreter without remuneration.

Figure 1. Al Hadida (Wabar) meteorite crater in the Rub 'al Khali, Saudi Arabia. (Photograph by Donald A. Holm, Aramco.)

50-yard wide area of slaggy material including dumb-bells, tear drops, black "pearls," and many other forms which we collected. While Don Holm and the two Arab drivers laid out an air strip so the plane could land safely, I continued to make collections and take photographs. We reached the area of the crater at 4:00 p.m., and had only two hours there because the air strip at Ubailah was not lighted for night landings.

There is only one crater exposed now, and which it is of the two mapped by Philby is uncertain, but it is probably the southeastern one. The sand is constantly moving, covering up old areas of ejecta and exposing new ones. An estimated 50 pounds of glass and shocked sandstone were collected, half of which Aramco sent to the U. S. National Museum. Dr. E. C. T. Chao of the U.S. Geological Survey received some of this material to examine for coesite, and found it to be present (*GeoTimes*, May-June, p. 14, 1961).

Australia and Australite

From Saudi Arabia we entered Australia via Darwin, after brief stops in Karachi, New Delhi, Calcutta, Kuala Lumpur and Singapore. We visited museums and tektite workers in Brisbane and Sydney on our way to Melbourne to see Dr. George Baker, the world's foremost australite expert. Four days were spent in the field in the vicinity of Port Campbell and Peterborough with the Bakers. This coastal area has yielded a number of perfect tektite buttons so fresh and unmarred that the amount of material lost by ablation can be measured, and from these measurements the speed and angle of entry of these tektites into the atmosphere can be calculated.

The coast for many miles is a sheer cliff one to three hundred feet high cut from flat-lying, argillaceous, Miocene limestone. The tektites are mostly found at the top edge of the cliff where spray of the splashing waves has washed away the soil and residual clay for a few feet. In places the limestone forms a bench a foot or two wide up to a hundred feet in more exposed areas, and in other places the clay slopes to the edge of the cliff. While collecting tektites one must watch for sudden gusts of wind as well as overhangs which might break off and pitch one into the ocean or to the rocks below. Some tektites have been found away from the cliff edge along old roads, and in borrow pits and road ditches washed and gullied by the rain.

During 26 years of hunting in this area the Bakers have yet to find a tektite *in situ*. Tektites have been found resting as high on the slope as the top of the buckshot laterite accumulation in the soil and apparently come either from the buckshot layer or from the overlying soil but not from the residual clay. Baker concludes that these australites arrived on earth between 3,000 and 5,000 years ago. All australites appear to have arrived in one shower; however, those in the desert areas are wind-abraded and etched and do not have the same fresh appearance as those from the Port Campbell area.

Indonesia

After stops in Canberra, Hobart, Adelaide, Alice Springs, Perth, and Kalgoorlie to see collections of tektites and Darwin

Figure 2. Safari at start of trip to Phang Daeng.

Figure 3. Buddist wat at Phang Daeng.

Figure 4. Living quarters on porch of wat at Phang Daeng; Dr. Kaset (on left) and driver.

glass, to visit the Henbury craters, and to consult with tektite workers, we flew to Djakarta and Bandung, Indonesia, where Dr. and Mrs. Joseph Lintz, Jr., sheltered us. President Soekarno was to be in Bandung the following day and there was not a room to be had. Dr. Lintz, who is with the Kentucky Contract Team teaching at the Technical Institute, drove me the 300 miles or so the the tektite area near Surakarta (Solo). Traffic was extremely heterogeneous and heavy except in rebel territory. There the villages are surrounded by pointed bamboo fences built in depth, with gates across the road which are locked before dark and not opened until after daybreak.

At the tektite locality near Solo we visited Totomarsono, headman of the village of Krikilan, from whom we bought a small collection of tektites. After the purchase he took us to one of the nearby tektite localities, a conglomerate-capped hill about a mile north of the village. The tektites were pointed out as coming from the topmost part of the hill, as well as down the flanks. If this is true there are two age possibilities for the tektites in this area: (1) They are reworked into the conglomerate from older rocks. (2) They fell during the deposition of the conglomerate. Potassium-argon dating indicates that (1) is the more likely.

The next day we explored another conglomerate-capped hill, having been led there by Dr. G. H. R. von Koenigswald's old guide, who had accompanied him during the time he found and collected the fossil remains of Java man. The eastern end of the Sangiran dome is clearly visible from this hill. This end of the dome is outlined by the erosional edge of the resistant conglomerate from which great quantities of vertebrate material weathers. As on the first day, we found no tektites and it would have been surprising if we had, for the residents of the area assiduously collect them, as well as fossil material, to sell.

Rich Thai Finds

From Indonesia we went to Bangkok, the city of great charm, friendly people, and beautiful temples. Two weeks were spent with Dr. Kaset Pitakpaivan, geologist, Geological Survey Division, Royal Department of Mines, investigating tektite localities in northeastern Thailand, an area that alternates between too much rain and drought. We were there near the start of the dry season, experienced only occasional showers, and the temperature was pleasant.

One of the localities I was anxious to examine, where a very special type of tektite occurs, was in a hilly or slightly mountainous area of Triassic sandstone 15 miles or more beyond the point where our Land Rover could reach. Dr. Kaset (first names

Figure 5. Excavating Muong Nong-type tektites near Phang Daeng.

Figure 6. Muong Nong-type tektite **in situ** in laterite, exposed at a depth of two feet in road bed near Nong Sapong.

are properly used in this fashion in Thailand) with the help of Mr. Bai, the hunter who was our guide and informant, organized a safari which, in addition to the three of us, consisted of a cook, policeman, 8 bearers, and the driver who went along for the walk but ended up doing most of the cooking. At the end of our trek we were housed, by the courtesy of the Buddhist monks, on the lean-to porch of the wat at Phang Daeng, about one-half mile from the tektite locality. Reportedly I was the first Occidental to visit this village and therefore was an object of much curiosity, especially when bathing. A bath here required considerable dexterity as it was done in the open air with a rectangle of cloth around one's middle while ladling water from pots carried for the occasion by the villagers.

The tekite locality I was so anxious to see, near Phang Daeng, is of the Muong Nong-type, so called because previously the only known deposit of this type was found near Muong Nong, Laos. The original locality was described by Alfred Lacroix in the proceedings of the Academy of Sciences, Paris, for 1935 under the title "Les tectites sans formes figurées de l'Indochine," which describes their appearance succinctly. I had long thought that the shapeless Muong Nong-type of tektite might hold the key to the origin of all tektites, and when a locality of similar type turned up in Thailand I was elated, since travel to Laos was not permitted by the time our trip was under way.

The Phang Daeng deposit we went to see was in laterite and was confined to an area a couple of yards across, beneath nearly a foot of soil, and had to be excavated. The tektite material revealed gave the appearance of having formed as a sort of puddle. It was roughly lens-shaped, and although the material was broken, with laterite separating the pieces, it was generally grouped together as a mass.

We hired eight villagers to help our bearers excavate the site and dig test pits in lines intersecting at right angles on the deposit. Twenty-five pounds or so of tektites were excavated from the site and perhaps as many more had been recovered previously by Mr. Bai and sent to Bangkok. No tektites were found in any of the test pits, but within a hundred yards to a half-mile ordinary tekties were found resting on soil formed on Triassic sandstone, and Dr. Kaset and I collected several dozen specimens.

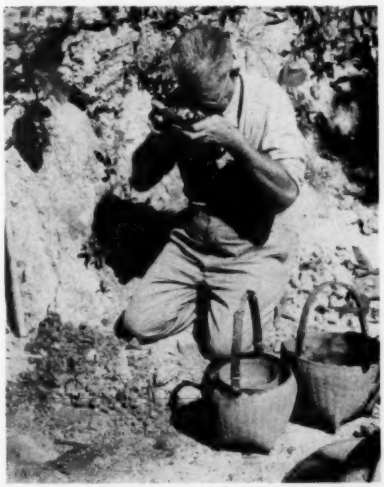


Figure 7. Barnes photographing Muong Nong-type tektite occurrence in roadway near Nong Sapong.

Figure 8. Laterite layer containing Muong Nong-type tektites beneath two feet of soil and above three feet of weathered sedimentary rock, 81 kilometers west of Sakhon Nakhon.

Figure 9. Tear-drop tektite in surficial buckshot laterite, 48 kilometers west of Khon Kaen.

After Phan Daeng, Mr. Bai led us to two other deposits. One was in a 6-foot-deep well near the village of Kan Luang Dong and the other was in a gullied roadway near the village of Nong Sapong. Later, after Mr. Bai left us, we found another locality of the Muong Nong-type along the highway 81 kilometers west of Sakhon Nakhon. This type of material, now known to be distributed over a distance of 220 miles, is interspersed with normal tektite types. Altogether, eleven new tektite localities were found during our two-week field trip in Thailand, and we examined seven localities previously reported.

By the time our Thailand work was finished I concluded it was likely that both types of tektites had been formed by the same event, probably a tremendous meteorite, asteroid, or comet impact producing an explosion sufficient to form and distribute the normal type tektites. During the arrival of the impacting object the accompanying heat wave might have fused bare patches of ground with the melted material flowing to low places to collect as puddles.

Such an impact area should be readily visible and perhaps the breached dome north of Kuchinari, reported by Wallace Lee in 1923 to the Royal Department of Mines, is such an impact site. This feature is remarkably similar in appearance to an impact crater and should be examined on the ground with this origin in mind. I first saw Lee's report after returning to Bangkok. Because of other commitments the schedule for the remainder of our trip had to be maintained, and the examination of this feature had to be postponed. If what is learned from the chemical evaluation of the tektites and associated material collected in Thailand indicates that a terrestrial impact origin is likely, then by all means the Kuchinari feature should be closely examined.

In Cambodia, with aid from the U. S. Operations Mission to Cambodia and guidance by Mr. Gaylord Walker, tektite localities reported by Prof. Edmond Saurin were examined and additional localities were found in the region of Kratié. A fine specimen was acquired at Snoul and several pounds of tektites were obtained from a jeweler in Phnom Penh. Because of impassable roads, the reportedly prolific deposits in the Rovieng area were inaccessible.

Operations Limited

In Viet-Nam, because of Communist activity, we were limited to the area around Dalat. Fortunately these deposits are extensive. At the suggestion of Prof. Edmond Saurin, we were guided by Mr. and Mrs. Adrien Milliés-Lacroix who have collected tektites in this area for a number of years. In two days' time the four of us found more than a thousand specimens including tear-drops, dumb-bells, rods, and plates—typical indochinites. Some of these were *in situ* in surficial materials, thus furnishing important geological information on their occurrence.

Manila was our destination after we left Viet-Nam. Here Dr. H. Otley Beyer has assembled a half-million tektites in the Museum and Institute of Ethnology and

(Continued on page 38)

The Goals of Project VELA

by CHARLES C. BATES [1]

Negotiations between the United States, the United Kingdom and the Union of Soviet Socialist Republics have been under way since October 31, 1958, in an effort to reach agreement on a treaty for cessation of nuclear weapons testing. As a result of these negotiations, on September 2, 1959, the Secretary of Defense assigned to the Advance Research Projects Agency (ARPA) the responsibility for research, experimentation and systems development to obtain at the earliest practicable date a system for the detection of nuclear explosions, both underground and for high altitudes. This project, known as VELA, is divided into three programs:

(1) VELA UNIFORM, which is concerned with the detection of underground nuclear detonations,

(2) VELA SIERRA, the detection of high-altitude nuclear detonations by instruments located in the earth,

(3) VELA HOTEL, the detection of high-altitude nuclear detonations by means of satellite-borne instruments.

Major funding for this program started in October 1959. As a result, in the first two fiscal years of the program, i.e., FY 60-61, a total of $51,438,000 has been provided, of which about $41.5 million has been assigned to UNIFORM, $4.3 million to SIERRA, and $5.6 million to HOTEL.

Because the interest of the readers of *GeoTimes* primarily lies in solid earth physics, the technical approaches being utilized in VELA SIERRA and HOTEL are described but briefly, and most of the paper delineates the technical, management and budgetary approaches being used in VELA UNIFORM.

In the SIERRA area, a variety of ground-based optical and electromagnetic techniques are being studied. These include detection of light and radio signals emitted from high-altitude nuclear detonations, detection of atmospheric changes induced by radiation or debris by optical and radio propagation measurements, and detection of effects on the earth's magnetic field. Quite clearly, natural phenomena such as solar activity, cloud cover, lightning, meteors, and aurora will affect detection and identification capability, consequently a major part of the program is concerned with understanding these phenomena. With reference to the VELA HOTEL area, extensive consideration is being given to the natural radiation background and the general environment in which the detection system must operate. Natural signals, e.g., solar flares, gamma and X-rays must be distinguished from signals emanating from test detonations. Consequently, scientific payloads and satellites are planned to obtain needed experimental data.

Returning to the problem of detecting underground nuclear detonations, one finds that the majority of information on the behavior of nuclear explosions buried at depths of greater than 100 feet comes from the five underground nuclear explosions fired at the AEC's Nevada Test Site between September 1957 and October 30, 1958, at which time the United States ceased all nuclear testing. Most of the energy released from completely buried nuclear detonations remains within a few hundred feet of the explosion site, with only two to four percent being propagated as elastic waves through the surrounding rock for tens to thousands of miles. Because of this, special attention has been directed towards the detection and identification of such explosions by seismic means. To consider means for improving detection at long range, in December 1958 the Special Assistant to the President for Science and Technology appointed a Panel on Seismic Improvement under the chairmanship of Dr. Lloyd Berkner to study the whole question of seismic detection and identification. Their report, fre-

[1] CHARLES C. BATES, Chief, Vela Uniform Branch, Nuclear Test Detection Office, Advanced Research Projects Agency, Department of Defense.

SCHEMATIC PATTERN OF VELA UNIFORM TASKS

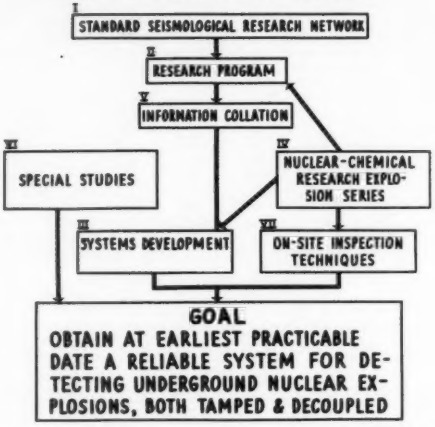


Figure 1

quently known as the "Berkner Report," became available on March 31, 1959, and has served as a valuable guide in setting the pattern for what is now VELA UNIFORM.

This project consists of research and development under seven general areas shown in Figure 1.

Because the 700 seismological stations of the world suffer from inadequate, non-uniform instrumentation, there is being created an international seismological research network utilizing 125 sets of modern, calibrated and standardized instrumentation on a cooperative basis. A broad program of seismological research is already under way for developing a thorough understanding of how a contained explosion produces a seismic signal, how such a signal is transmitted to surface points at various distances, and how one may discriminate between seismic signals from earthquakes and sub-surface detonations, whether nuclear or chemical, in the presence of various types of noise. Exploratory development work for improving detection, processing, analysis and display equipment and techniques also falls under this task. Table I lists the present contractors engaged in this effort.

Whenever the results of the research effort appear promising, they are tried experimentally under a systems development effort wherein prototype detection components, stations, and systems are developed and evaluated for possible use in a nuclear test control system.

No matter how extensive the VELA UNIFORM research and systems development effort may be, the only sure way to determine the degree of safeguards offered by a nuclear test ban treaty is the actual firing of a minimal number of underground explosions. Although chemical explosions can be used to substitute for nuclear explosions to some extent, inherent differences in the two types of detonations are great enough to require a combined nuclear-chemical research explosion series for adequately testing detection theories, instruments, techniques, proposed treaty control stations, and on-site inspection methods. Present plans call for approximately 11 to 13 completely contained underground nuclear detonations and for about 23 underground chemical explosions. These will be fired at various depths, yields, locations and cavity sizes. A number of these would be at the Atomic Energy Commission's Nevada Test Site; two sites in Mississippi, the Tatum and Bruinsburg salt domes, are also under extensive consideration for decoupling experiments. It is to be stressed that these nuclear detonations are currently only planned, and actual firing of the nuclear devices will not take place until specifically authorized by President Kennedy. At the suggestion of the Society of Exploration Geophysicists, a technical coordination service for the cooperative monitoring of these research explosions by commercial geophysical crews has been set up by the Geotechnical Corporation of Garland, Texas, under the direct supervision of the Air Force Technical Applications Center, the principal government agent responsible for off-site seismic measurements in VELA UNIFORM. A special radio service for notifying cooperating observers of count-down details is also being arranged by the Defense Atomic Support Agency.

VELA UNIFORM RESEARCH PARTICIPANTS

1 APRIL 1961

SEISMIC

SOURCE MECHANISMS:
- U. Calif. (Berkeley)
- Penn State
- St. Louis U.
- Columbia U.
- United Electrodynamics
- Sandia Corp.

PROPAGATION PATH:
- U.S. Geol. Survey
- St. Louis U.
- UCLA-CalTech.
- Uppsala U.

PROPAGATION PHENOMENA:
- CalTech
- Columbia U.
- Weizmann Inst.
- Stanford Res. Inst.
- U. Oklahoma
- Calif. Res. Corp.

SIGNAL DETECTION:
- U. Mich.
- Columbia U.
- CalTech.
- Geotech Corp.
- Jersey Prod. Res.
- Texas Inst.
- Drosser Ind.
- Electro-Mechanics Co.
- Rensselaer Inst.

SIGNAL ANALYSIS & DISPLAY:
- U. Mich.
- U. Calif. (LaJolla)
- CalTech
- Columbia U.
- Mass. Inst. Tech.
- Texas Inst.
- Bell Labs.

Table 1

Provision has also been made for developing and testing the on-site inspection techniques necessary for determining whether an unidentified seismic event was either a natural event or a subsurface explosion and, if the latter, whether it was chemical or nuclear in origin. There are also standing arrangements for special studies whenever they are needed by the executive branch of the government. With the rapid growth of VELA UNIFORM, there is need for a technical literative digesting service capable of rapidly collating, reviewing, abstracting and disseminating the results of published and unpublished seismic research and related technology, whether VELA UNIFORM sponsored or not, to those interested in the program. Accordingly, arrangements have been completed for this function to be handled by the specially organized VELA Seismic Information Analysis Center (VESIAC) at the University of Michigan Institute of Science and Technology.

It is a striking fact that this country has no single major center, governmental, industrial, or academic, possessing the breadth required for handling all the concurrent work needed in VELA UNIFORM. As a result, several agents are handling on ARPA's behalf the forty major contracts in the VELA UNIFORM program, each agent being assigned a specific technical area as shown in Figure 2. The actual management mechanism includes the following:

(1) ARPA defines the specific problem area.

(2) An ARPA Order is issued describing the work to be done, the funds available, the reporting procedure and the Order's effective period. These Orders are usually directed to an agent, who may undertake the task internally. In other cases, the agent may contract for the work with a university, a nonprofit agency or an industrial concern.

(3) The agent is made responsible for the detailed technical supervision and administration of the assigned work. The agent maintains contact with the scientists doing the work, receives the reports, comments on them and takes appropriate action. ARPA also receives a copy of each report which is reviewed by the staff. When guidance is needed, ARPA provides it to the agent; if ARPA is immediately responsible for the work, the guidance is given directly to the contractor.

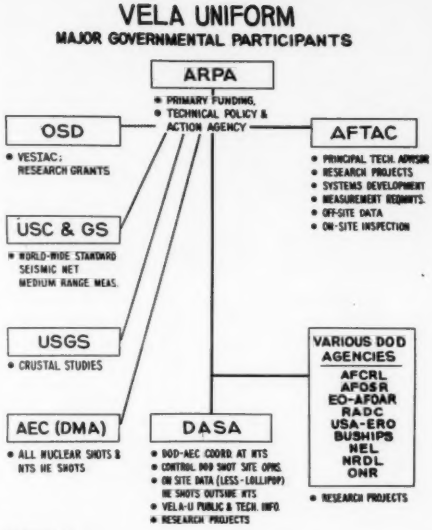


Figure 2

(4) The ARPA staff periodically reviews all work under the Project. The findings are also summarized for ARPA's Ad Hoc Group on Detection of Nuclear Detonations which provides further technical guidance. In addition, one general summary of the Project was held in the form of a symposium in October 1960. A second symposium is planned for the latter half of 1961.

Regular project guidance is received from the Office of the Special Assistant to the President for Science and Technology, and certain aspects of the VELA Project have also been reviewed by the President's Scientific Advisory Committee. The U. S. Disarmament Administration in the Department of State also maintains close contact through the Office of the Assistant Secretary of Defense for International Security Affairs.

Turning to action agents, the Air Force Technical Applications Center (AFTAC) is ARPA's major technical advisor. AFTAC is also ARPA's technical agent for the systems and on-site inspection technique development tasks, as well as for certain aspects of improved seismic instrumentation, data display, and teleseismic field measurement techniques.

In the important nuclear-chemical research explosion series, the conduct of which has not yet been authorized, AFTAC codifies the technical requirements for the entire measurements program and directs the acquisition of off-site seismic measurements. In this shot series, the Atomic

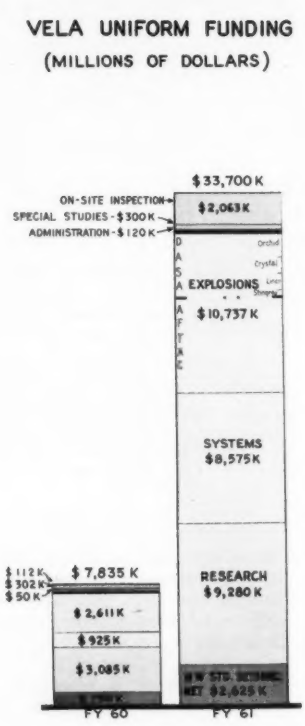
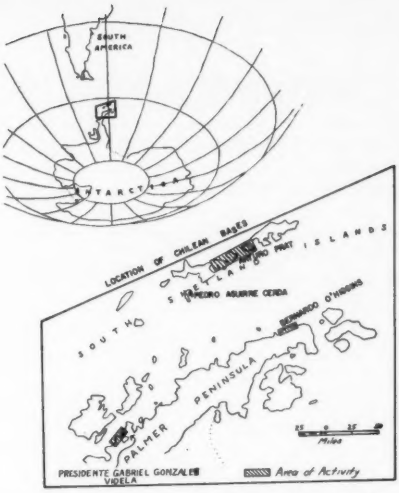


Figure 3

Energy Commission (AEC) is responsible for providing the nuclear devices, the sites and cavities in which to fire the devices, the actual firing, and the making of measurements directly associated with such firing. In addition, similar support will be provided by the AEC for all chemical detonations at the Nevada Test Site. The third key activity in the shot program is the Defense Atomic Support Agency (DASA) which coordinates all Department of Defense activities at the various shot sites, manages the necessary close-in measurement programs to observe the conversion of shock waves to elastic waves, and executes all chemical explosions required outside the Nevada Test Site. In addition, DASA has accepted the responsibility to conduct research studies aimed at developing a comprehensive theory of the generation of seismic wave spectra by a theoretical and experimental study of close-in phenomena associated with large-scale detonations under various types of containment. DASA also provides the public and technical information service for this portion of VELA UNIFORM. In addition to the government agencies previously mentioned the Air Force Cambridge Research Laboratories (AFCRL) is the agent for applied seismology, the Air Force Office of Scientific Research (AFOSR) for basic seismology and allied sciences, and the Rome Air Development Center (RADC) is an agent for underground electro-magnetic pulse investigations. Foreign seismic research has been arranged through the European Office of the U. S. Army (ERO-USA) and the Office of the Secretary of Defense (OSD). The United States Geological Survey (USGS) has also undertaken for ARPA a major investigation of seismic propagation paths in southern California and Nevada. In addition, limited investigations pertinent to the detection of subsurface nuclear explosions at sea are being conducted under the auspices of the Office of Naval Research (ONR) and the Bureau of Ships' Naval Electronics Laboratory (NEL) and Naval Radiological Defense Laboratory (NRDL).

The allocation of VELA UNIFORM funding has been as follows (see Figure 3). In FY 60, the initial year of the program, $7,835,000 was made available, including $375,000 of DASA funding. About 40% of this went into initiating the research program, and another 35% went into preparing for the series of chemical and nuclear research detonations. The other tasks, namely, Systems Development, World-wide Standard Seismic Network, Special Studies, On-Site Inspections, and Information Collation, received less than a million dollars each. FY 61 funding of $33,700,000 permitted the program to operate on a full-fledged basis for the first time. The $10.7 million allocated for the research explosion series is closely followed in magnitude by allocations of $9.3 million and $8.6 million allocations to the research and systems development tasks, respectively. The cost of establishing and operating the World-wide Standard Sesimic Network reached its peak of $2.6 million during FY 61 and will decline to less than a million dollars a year thereafter. $2.1 million has also been made available for work on on-site inspection, while the amounts of $300,000 and $123,000 are assigned to special studies and information collation, respectively.

In summary, VELA UNIFORM—in an effort to obtain quickly solutions to one of the urgent questions now facing our government—has grown into the largest national effort currently directed at one facet of earth science. We invite your ideas for research aimed at achieving answers to a major national problem.



Antarctic Geologic Studies on North Palmer Peninsula

by MARTIN HALPERN [1]

During the 1960-61 austral summer a joint scientific cooperative program supported by the governments of Chile and the United States was carried out in the north Palmer Peninsula (Tierre de O'Higgins). The five scientists participating from the U. S. were: John O. Annexstad (geophysicist, U. S. Coast & Geodetic Survey); Martin Halpern (geologist, University of Wisconsin); Thomas S. Leech (entomologist, Bernice P. Bishop Museum); Robert E. Leech (entomologist, Bernice P. Bishop Museum); David A. Link (geologist, University of Wisconsin). All logistic support in Chile and Antarctica was supplied by the government of Chile.

In the north end of the Palmer Peninsula, the Chilean government maintains four bases throughout the entire year. Intense crevassing and the rugged topography of the Cordillera of the Antarcandes, which rise sharply and abruptly from the coastline, makes inland traversing extremely dangerous. However, because of high summer temperatures (av. + 30° to + 34°F) good rock outcrop exist in the coastal areas, so field mapping was confined to accessible areas neighboring the Chilean bases.

In summary, the field geology was as follows:

Base Arturo Prat (Greenwich Island) the geologic setting is one of Cenozoic basalts, agglomerates and intrusive gabbro.

Base Gabriel Gonzalez Videla (Lat. 64°49'24.8"S., Long. 62°51'34.8"W.) Here mainly granitic intrusives into metagraywacke and metaconglomerate were encountered. Figures 1 and 2 show the ruggedness of the terrain surrounding this base, which is now maintained by the University of Chile as a scientific station. The rock outcrop in the foreground of Figure 1 is dominantly metasediments cut by acidic intrusives along the shoreline (not distinguishable in the photograph). Figure 1 is a view to the SE, looking at the Cordillera of the Danco Coast while Figure 2 looks NW at Isla Lemare in the De Gerlache Strait: In Figure 1, the buildings are the geomagnetic installations and the penguins in the foreground are of the *chinstrap* species. The building in Figure 2 is the boathouse.

(Continued on page 40)

Figure 1. The rocks in the foreground of this photo, taken at Base Gabriel Gonzalez Videla, are metasediments which, along the shore line, are cut by acidic intrusives. The Cordillera of the Danco Coast is in the background.

Figure 2. A view of Isla Lemare in the De Gerlache Strait taken from Base Gabriel Gonzalez Videla.

[1] MARTIN HALPERN, Department of Geology, University of Wisconsin, Madison.

NATURAL RESOURCES of the U.S.S.R.[1]

by PYOTR Y. ANTROPOV[2]

Drawing on the explored deposits of coal; oil; ferrous, nonferrous and rare ores; mining and chemical raw materials, we are planning to set up a third metal-making center in the eastern part of the country. A further impetus will be given to nonferrous metallurgy in Kazakhstan, the Urals, the Baikal area and the Kola Peninsula, and the expansion of the oil, gas and chemical industries will be speeded up in some of the areas.

A vital economic problem under our seven-year plan is to sharply increase the share of oil and gas in the country's fuel supply. To this end, a far-reaching expansion program has been drawn up for the petroleum industry.

New oil deposits have been explored in the vast area between the Urals and the Volga, named the Second Baku. More than 100 oil deposits and 250 potentially oil-bearing areas have been discovered in Tataria, Bashkiria, the Perm, Orenburg, Kuibyshev, Saratov and Ulyanovsk Regions. Major sources of natural gas in recent years have been found in many areas in the Soviet Union, notably in Western and Eastern Siberia, Central Asia, the Northern Caucasus and the Ukraine. Extremely profitable for exploitation are the huge gas deposits in the Bukhara-Khiva Depression. The explored reserves of gas in the Gazli field alone are estimated at 500 billion cubic meters.

While in the past the chief oil producing areas in Russia were Baku, Grozny and, to a degree, Maikop, the geography of oil production has sharply changed during the Soviet years. Though considerably much more oil is now produced in the Caucasus, the hub of the petroleum industry has now shifted to the Volga-Ural area. Undoubtedly new rich oil-producing fields will soon appear in Uzbekistan, Turkmenistan, Tajikistan, Kirghizia and Kazakhstan. The Caspian Depression, covering an enormous territory within Turkmenia, Kazakhstan and the Russian Federation will, it is expected, become a major oil-producing area, too.

Assessing the prospects of Central Asia and Kazakhstan, one cannot fail to notice a certain geological similiarity between the two areas and the Middle East, the chief oil producer in the world.

Particularly attractive from the viewpoint of oil exploration are the West Siberian Depression (embracing the Tyumen, Omsk, and Tomsk Regions), the Turgai Sag and many other areas in Eastern Siberia, the Soviet Far East and Northeast. They have numerous potentially oil-bearing structures, though commercial oil deposits have not as yet been found there (except for Sakhalin Island). The explanation should probably be looked for in the poor quality of studies conducted in the past. Putting it another way, oil has not been found because it has not been looked for well enough, rather than because there is no oil at all. This has been borne out by the prospecting and exploration work done in the last few years when major gas-bearing areas were discovered in the West Siberian Depression (Tyumen Region) and in the Vilui Valley, Yakut Republic.

A veritable revelation has been the Mulymyin oil deposit found this year 400 kilometers south of the Berezova gas field in the Tyumen Region. The high oil yield obtained is an indiction of highly oil-bearing strata in the West Siberian Depression and, above all, in the margins of the Khanty-Mansy Depression. Thus it can be hoped that geologists will soon discover not only isolated oil and gas deposits, but also new large oil and gas-bearing provinces.

Under the seven-year plan the share of oil and gas in the country's fuel supply is to rise to 51 per cent, and that of coal to drop from 60 to 43 per cent by 1965. This calls for an appropriate increase in oil production: from 113 million tons in 1958 to 230 or 240 million tons toward the end of the seven-year period. On the average, the annual increase in oil output in the meantime will be 16.7 to 18.1 million tons, while the figure in 1956-1958 was 14.1 million, and 6.6 million in 1951-1955.

To attain this goal 19 to 20 thousand more wells will have to be drilled and brought into production. The explored oil reserves of the Soviet Union are planned to grow by another 70 per cent during the next seven years.

(Continued on page 42)

[1]This article is reproduced as it was received by GeoTimes from the Press Department, Embassy of the U.S.S.R., Washington, D. C. and is presented without editorial comment.

[2] PYOTR Y. ANTROPOV, U.S.S.R. Minister of Geological Survey and Conservation of Mineral Resources, Moscow. P. Antropov is also the author of an article, *The Earth's Riches Are Incalculable* appearing in a volume on the Mineral Wealth of Madhya Pradesh, Vol. 2, No. 4, July 1959, p. 87-88, Quarterly Journal, Dept. of Geology & Mining, Government of Madhya Pradesh, Raipur, India.

Language Barriers in Earth Science

by K. O. Emery and Bruce D. Martin [1]

Since the invention of the printing press the quantity of material printed each year has risen almost logarithmically. This rise is evident in technical literature whether expressed in terms of numbers of pages or numbers of titles (Emery, 1951). Moreover, it is occurring in many different languages, so that a scientist of a given field is faced not only by a flood of publications in his own language but by similar floods in other languages. Since there is a limit to his time and ability to absorb this material, the scientist may choose to specialize in a field so small that he can read most of the literature or he may choose to cover a larger field and ignore most of the literature, particularly that which is difficult to read or to obtain. The latter trend is so deplorable that an effort was made to determine its present extent.

The method which was chosen was that of tabulating the number of titles in various languages which were listed as references by the authors of papers and books of the same various languages. The languages for which tabulations were made are English, French, German, Japanese, Russian, and others grouped together as miscellaneous (including Danish, Dutch, Polish, and Spanish). The language of the titles listed among the references nearly always correspond to that of the country in which the journal or book of the reference was published. Accordingly, the tabulation really was based upon the country of origin of the reference. This fact made possible the separation of articles and books published in the United States from those in Great Britian, allowing an estimate to be made of the relative importance of language barriers and availability barriers.

Tabulations were made for 1959, the most recent year for which library collections were complete. For each country four classes of publications were selected: a general science journal, a geological journal, one or more books on marine geology, and one or more books on general oceanography. The books which were chosen were ones of world-wide, not local, import. Exact parallels do not exist in the literature of all the countries, but the selections are approximately uniform. Obviously, bias factors occur in the statistics of such a study. Among them is the fact that most articles on geology describe limited areas for which previous work has been published in only the local language. There is less provincialism to be expected of general science and of marine geology and still less of oceanography because of the nature of the fields. Another minor problem is the classification of references to truly international journals such as Deep-Sea Research, Geochimica et Cosmochimica Acta, and Journal Conseil Permanent International pour l'Exploration de la Mer. The question was resolved in favor of the country in which the journal is published regardless of the language or source of individual articles within the international journals.

Even a cursory examination of the tabulations (Tables 1-4) shows a decided preference of authors for references published in their own countries. As far as these data permit interpretation, this preference is most extreme for Russian and American authors, as previously reported by Gross and Woodford (1931) Terry and Chilingar (1956). An average of about 75 per cent of all references cited by Russian authors are of Russian sources, and 61 per cent of those cited by American authors are of American sources. Most international in their source references are British authors with their average of only 39 per cent British sources. Japanese journals also contained only 39 per cent Japanese sources. The second most frequent source of references is to American literature (except in German books which more commonly refer to British sources, and of course American journals and books for which British references are second most frequent). This preference for American sources is especially characteristic of Russian authors and many of these source references are to very obscure journals. Least frequent as nonnative references are Russian and Japanese sources.

One can conclude that:

1. Most frequent are references to sources from the same country as the author, evidently because of familiarity with language and ease of access.

2. The second most frequent source is to American and British literature, probably because English is the most familiar foreign language of the scientific world.

3. The least frequent source is to Russian and Japanese literature, evidently a result of both lack of familiarity with the

[1] K. O. Emery and Bruce D. Martin, Department of Geology, University of Southern California, Los Angeles.

GENERAL SCIENCE JOURNALS

Table 1

	NUMBER ENTRIES	PERCENTAGE DISTRIBUTION OF REFERENCES						
		American	British	French	German	Japanese	Russian	Miscel.
American (Science)	2972	61.3	16.6	2.5	5.1	1.7	1.6	11.2
British (Nature)	2555	34.6	39.2	3.1	6.4	0.6	1.0	15.1
French (Academie des Sciences, Comptes rendus des Seances, Paris)	646	14.9	6.3	52.5	15.0	0.6	0.6	10.1
German (Naturwissen-schaften)	1525	28.3	20.2	4.4	35.7	1.0	0.1	10.3
Japanese (Japan Academy, Proceedings)	759	27.7	14.4	5.4	7.9	35.5	0.8	8.3
Russian (Akademiya Nauk SSSR, Doklady)	11848[a] 17262[b]	12.2 14.6	4.6 6.6	2.5 2.8	7.5 7.7	0.4 0.9	67.7 62.1	5.1 5.3

a - 1955
b - 1959

GEOLOGY JOURNALS

Table 2

	NUMBER ENTRIES	PERCENTAGE DISTRIBUTION OF REFERENCES						
		American	British	French	German	Japanese	Russian	Miscel.
American (Geological Soc. of America Bulletin)	974[a] 2470[b]	36.1 70.4	4.6 7.1	1.7 2.1	9.2 3.6	3.9 0.2	19.2 0.4	25.3 16.2
British (Geological Soc. of London Quarterly Jour.)	661	25.0	47.0	2.3	5.2	0.4	1.4	18.7
French (Societe Geologique de France Bulletin)	1646	10.1	6.3	64.3	8.2	0.2	1.4	9.5
German (Geologische Rundschau)	404	4.7	3.2	4.7	65.1	0.8	0.0	21.5
Japanese (Japanese Jour. of Geol. and Geography) (Sci. Council of Japan)	574	18.8	4.7	3.0	11.1	42.0	3.0	17.4
Russian (Akademiya Nauk SSSR, Izvestiya Seriya Geologischeskaya)	1554	3.7	1.2	0.4	3.5	0.4	85.4	5.4

a - One article - a geochemical review
b - All other articles

languages and difficulty of access to publications of these countries.

4. In summary, one must conclude that science is proceeding in each country largely independently of progress in other countries. This is a method which is extremely wasteful of manpower, facilities, and time, although it does provide independent confirmation of ideas and techniques. Its existence means that probably a majority of scientists tacitly assume that it is easier to make independent discoveries than to learn of other prior work when the latter is reported in an unfamiliar language.

References

ANDREE, K., 1920, *Geologie des Meeresbodens*, Vol. II. Gebrüder Borntraeger, Leipzig, 689 pp.

BARNES, H., 1959, *Apparatus and Methods of Oceanography*, Pt. 1, Chemical: Interscience Publishers, Inc., New York, 341 pp.

BARNES, H. 1959, *Oceanography and Marine Biology:* G. Allen & Unwin, Ltd., London, 218 pp.

BOURCART, J., 1949, *Geographie du Fond des Mers, Etude du Relief des Oceans:* Payot, Paris, 303 pp.

DIETRICH, G. AND K. KALLE, 1957, *Allgemeine Meereskunde, Eine Einführung in die Ozeanographie:* Gebrüder Borntraeger, Berlin, 492 pp.

EMERY, K. O., 1951, *Trends in literature on sedimentology:* Jour. Sed Petrology, vol. 21, pp. 105-108.

MARINE GEOLOGY BOOKS

Table 3

	NUMBER ENTRIES	PERCENTAGE DISTRIBUTION OF REFERENCES						
		American	British	French	German	Japanese	Russian	Miscel.
American (Shepard)	234	70.6	9.8	0.4	3.8	2.1	1.7	11.6
British								
French (Guilcher; Bourcart)	1155	28.8	11.6	34.8	10.8	0.4	0.8	12.8
German (Andree)	692	8.8	12.8	7.5	57.6	0.3	1.3	11.7
Japanese (Tayama)	79	6.3	1.3	0.0	8.9	81.0	0.0	2.5
Russian (Leontev; Klenova)	701	12.1	5.1	1.4	10.1	0.0	64.3	7.0

OCEANOGRAPHY BOOKS

Table 4

	NUMBER ENTRIES	PERCENTAGE DISTRIBUTION OF REFERENCES						
		American	British	French	German	Japanese	Russian	Miscel.
American (Heck; Sverdrup, Johnson, & Fleming)	1393	42.2	19.4	1.8	15.3	1.1	0.7	19.5
British (Harvey; Barnes; Proudman)	1095	34.9	30.5	2.5	8.5	3.4	0.5	19.7
French (Rouch)	389	12.8	7.4	52.3	12.8	0.5	0.8	13.4
German (Dietrich & Kalle)	352	6.5	13.9	3.1	59.7	2.3	0.6	13.9
Japanese (Wadachi)	161	19.9	24.2	3.1	12.4	36.7	0.6	3.1
Russian (Snezhinski)	158	4.4	3.8	4.4	4.4	0.0	77.9	5.1

GROSS, P. L. K. AND A. O. WOODFORD, 1931, *Serial literature used by American Geologists:* Science n.s., vol. 73, pp. 660-664.

GUILCHER, A., 1954, *Coastal and Submarine Morphology:* John Wiley and Sons, Inc., New York, 274 pp. (English translation).

HARVEY, H. W., 1955, *The Chemistry and Fertility of Sea Waters:* Cambridge Univ. Press, Cambridge, England, 224 pp.

HECK, N. H. (chairman), 1932, *Physics of the Earth—V, Oceanography,* Bull. National Research Council, No. 85, Washington, D. C., 581 pp.

KLENOVA, M. V., 1948, *Geologia Morya (Geology of the Sea):* Gosudarstvennoe Uchebno-Nedagogicheskoe Uzdatelstvo Ministerstva Prosveschenia RSFSR, Moscow, 493 pp.

LEONTEV, O. K., 1955, *Geomorfologia Morskuk Beregov i Dna (Geomorphology of Marine Shores and Bottoms):* Izdatelstvo Moskovskovo Universiteta, Moscow, 378 pp.

PROUDMAN, J., 1953, *Dynamical Oceanography:* Metheun & Co., Ltd., London, 409 pp.

ROUCH, J., 1943, *Traite d'Oceanographie Physique:* Payot, Paris, 1018 pp.

SHEPARD, F. P., 1948, *Submarine Geology:* Harper & Bros., New York, 348 pp.

SNEZHINCKI, V. A., 1954, *Praktechekaya Okeanografeya (Practical Oceanography):* Gedrometerologischeskoya Izdatelstvo, Leningrad, 671 pp.

SVERDRUP, H. U., JOHNSON, M. W., FLEMING, R. H., 1942, *The Oceans:* Prentice-Hall, Inc., New York, 1087 pp.

TAYAMA, R., 1952, *Coral Reefs in the South Seas:* Bull. Hydrographic Office of Japan, Maritime Safety Agency, Publ. No. 941, 3 vols., 425 pp.

TERRY, R. D. AND CHILINGAR, G. V., 1956, *Selected list of Russian references of sedimentology:* Trans. Amer. Geoph. Union., vol 37, pp. 245-251.

WADACHI, K., 1960, *Kaiyo No Jiten (Encyclopedia of the Oceans):* Tokyo-dot, Tokyo, 671 pp.

THE LUNAR SURFACE

by Roy G. Brereton [1]

For centuries, man has tried to account for the grandeur of the surface features of the earth by conjecturing a mysterious catastrophism which rent and disrupted the whole earth, forming the present ocean basins and continents, and fashioning mountains, canyons, and narrow gorges. Geological evidence now largely negates the need for such sudden and abrupt forces. For example, one may point to the small and almost unobservable changes now occurring on the earth's surface; these are quite sufficient, if continued long enough, to produce results of great magnitude. Thus, the concept of *uniformitarianism* and slow evolution has replaced the concept of catastrophism.

For the earth, internal forces connected with diastrophism and epeirogenic processes slowly uplift or sink large segments of the crust to form mountains and other constructional land-forms, while the forces of weathering and erosion operate to sculpture and ultimately destroy the elevated region. Terrestrial surface features are thus seen to be the net effect of internal forces of construction and external forces of weathering and erosion.

[1] Roy G. Brereton, Space Science Division, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, Calif.

Although the surface of the moon is now peaceful and quiet, the grandeur and nature of the lunar landscape mutely attest to a powerful process of construction. There are great mountain ranges such as the Apennines that extend for hundreds of miles and contain peaks in excess of 20,000 feet. Some lunar mountains are more than 30,000 feet high. The towering Leibnitz and Dorfel Mountains, unfortunately never well seen owing to their position near the edge of the visible lunar disk, are estimated to be a full 30,000 feet in height. All these lunar mountains are far higher relatively than the earth's mountains, since they rise from a globe only one-fourth the diameter of the earth.

Crater-like structures are found over the entire surface of the moon; thousands have been counted. They differ greatly in size, the diameter of the largest, Bailly, is 183 miles, while the smallest visible with the most powerful telescope are only a few hundred feet in diameter. Smaller ones can be postulated, of course. The rim of a crater may stand as much as 10,000 feet above the surrounding country, and sometimes the floor of the crater is lower, sometimes higher, than the plain outside. The deepest creater, Newton, has a differential height between rim and floor of nearly 30,000 feet. A number of lunar craters are comparable to terrestrial craters known to have been caused by meteors and undoubtedly some originated in this way. Others are located along fissures in the moon's surface and seem to be associated with faults or volcanic phenomena. Great valleys also exist. The Rheita Valley is 100 miles long, 15 miles wide, and approximately 1,500 feet deep. In proportion to the moon's size, this is a chasm equal to earth's Grand Canyon.

To explain these constructional land forms, two constrasting theories of catastrophism have been suggested. The first and most generally accepted is the theory of meteor impact; the second is the theory of a molten moon with a consequent violent and global evolution of gases. The scientists who support these two theories refuse to apply concepts of *Uniformitarianism* to the moon. They appeal to the spectacular, the sudden, and the extraordinary to explain the varied relief of the lunar surface and the origin of the surface itself.

Impact Origin Limited

The impact theory seems very plausible at first; however, there are a number of fundamental objections that certainly caution against the universal application of this idea. For example, meteor impact does not adequately explain the distribution, varied shape and structure, or the geometrical arrangement of lunar craters. The craters are obviously not distributed at random over all the moon's surface; rather, they are clustered in certain geographic areas. Meteors obviously would not choose to fall on the elevated continental regions instead of on the depressed mares. When one crater infringes upon or breaks into another, it is always the larger crater which is damaged, and although the larger meteors during the formative accretion process of the moon would in general have fallen first, there should be at least a few exceptions to the rule; but there are none. The hilltop craters, nestled neatly on top of many central peaks, are very difficult to explain on the basis of random meteor impact. How could the chance hit of a meteor punch holes in the top of so many of these features. Finally, how could meteor impact possibly form lunar mountains, elongated valleys, elevated plateaus such as the Wargentin, and separate the moon into two distinct first-order geomorphic provinces comprising elevated continents and depressed mares.

Meteor impact has probably played an important part in the development of the lunar surface; especially in regard to formation of certain craters, magmatic nuclei, microstructures, and lunar dust; however, the formation of the diverse and grand constructional "land forms" displayed on the lunar surface, and the division of the moon into dark-colored depressed areas—mares—and lighter-colored elevated areas—continents—is more likely related to an internal, fundamental magmatic process associated with the moon's early thermal history.

The origin of the heat required to support a lunar magmatic stage is a difficult problem, filled with speculation. In the case of our earth, direct observation and measurements are possible. For example, geophysical measurements have disclosed that not only is the center of the earth extremely hot, and on the basis of seismic data probably molten, but enough heat has been generated in the past to completely stratify our layered earth into a dense core, surrounded by a less dense mantle, which is in turn overlaid by an even less dense crust. In addition, geological observations of volcanic activity, constructional land forms, heat flow, and other data all attest to a powerful heat source within our planet. For the moon, unfortunately, these observations and measurements are not yet available, and we must rely on inference and inductive reasoning for information.

GEOLOGICAL PERIOD	TIME 10^9 YEARS	CHEMICAL COMPOSITION	TEMPERATURE	REMARKS
Gas and dust	4.5	H_2, H_2O, NH_3, CH_4, Silicates, hydrated minerals, FeO, FeS, etc.	0°C	Formation of sun and deuterium cycle. With increased temperature and pressure, the sun evolved to present carbon cycle.
Planetesimal	4.0 to 4.5	Same as above but with loss of volatile elements.	0° to 300°C	Accretion of the moon.
Thermal	1.5 to 4.0	Same as above but with increased loss of volatile elements and gases. Formation of some metallic iron.	Interior slowly increased to 1780 to 2000°C. At depth of 100 km the temperature slowly increased about 500°C.	Temperature of moon increased by radiogenic heating. Possibly some gravity stratification with incipient core formation.
Magmatic	0.5 to 1.5	Increased loss of volatile elements because of degassing. Differentiation of magma-formed diverse rock types and some mineral deposits.	500°C to 1700°C localized	Formation of magmatic nuclei by meteorites or faulting. Development of continents and first-order geomorphic features.
Cooling	Present to 0.5	Considerable meteor material added to surface. Continued loss of lighter elements and gases.	Interior only slightly cooler, but at 100 km depth the temperature is less than 100°C. Magmatic areas are now cool.	Limited surface volcanism may still exist, but thermal activity is now too weak to form first order construction land forms.

Table 1. Thermal history of the moon.

Heat Sources

It appears that several sources of heat were probably available for heating the primal moon. These included three principal sources—radioactivity, meteor aggradation, and gravitational compaction; and two secondary sources—meteor impact and faulting.

For the earth, the principal sources of heating combined to produce the first molten condition some 2×10^9 years after aggregation. In the case of the moon, however, the lower initial temperatures delayed the time at which near molten interior conditions prevailed. Also, the thermal conductivity of lunar material delayed the conductive [2] transfer of heat from the hotter interior to a near surface environment; therefore, the lunar surface probably acquired its maximum temperature some 10^9 years after initial molten conditions developed in the center of the terrestrial globe, and these conditions probably prevailed for another 10^9 years. It was during this period that a secondary heat source triggered a near-surface magmatic phase that formed the lunar continents and mares, and contributed to the genesis of the whole lunar surface.

In regard to the generation of heat by meteor impact, many objects varying in size from dust particles to large planetesimals must have collided during the accretion process of forming the moon. The energy liberated to heat the primal moon would be a function of both the velocity and mass of the colliding particles. If we accept an accretion hypothesis, the heat generated from this source must have been considerable. This would add to the basic temperatures caused by gravitational compaction and radioactivity. In addition, however, large fragments upon striking the surface of the already warmed moon could produce enough heat energy to bring about a localized magmatic stage. For example, a one-gram mass with the modest escape velocity of 2.4 kilometers per second would arrive at the surface with an energy of 2.9×10^{10} ergs. This is sufficient to raise the temperature of a similar mass of basic silica material from O°C to about 2100°C.

Earthquakes

Earthquakes must have been more numerous in the primal moon because it was then closer to the earth where tidal forces could be more effective. Earthquakes liberate, rather suddenly, energy that has been stored in deformation or as elastic energy. Part of this liberated energy was dissipated throughout the entire body of the moon and so had little thermal effect, but the earthquake energy that caused faulting produced large quantities of localized heat that could have produced melting on a relatively large scale. It should be observed that a high degree of seismic activity would be expected for an

[2] Transfer of heat in the case of a molten globe is convective.

initially cold moon that was subsequently heated by radioactivity. If a cold moon with a uniform distribution of radioactivity is considered, the greatest rate of release of strain energy (faulting) would likely occur within a depth range from the surface down to 700 km.

Obviously, if the surface of the moon were already warm, both the secondary heat-producing processes discussed here could generate the magmatic nuclei necessary for further epeirogenic and volcanic evolution of the surface. The sequence of events relating to the thermal history of the moon are described in Table 1.

It is not likely that the melting process was ever strong enough to make the whole surface of the moon completely molten, but enough heat was available to cause localized near-surface magmatic phases. Subsequent differentiation and protracted cooling of these batholithic magmatic areas generated continental nuclei. The crater-marked continents of the moon represent the regions of magmatization and greatest heat flow. Here more silicic rock types form the first few kilometers of the surface. Under this material, polymorphic, low-density (high-volume) mineral phases generated in the greater temperature environment of the cooling magma cause the continental areas to stand high above the denser undifferentiated mares.

A magma composed of molten silicates would normally solidify from the bottom upward, since as the hot solution cools, a point is reached where some compounds or minerals become insoluble in the cooling solution, and therefore crystallize out. These solid silicates are more dense than those of the liquid phase; therefore they settle towards the bottom of the magma chamber. These crystals and silicate phases, at temperatures not far below their melting points, are readily remelted deep within the magma chamber. Thus, by a process of fractional crystallization, differentiation, solidification and remelting, the surface of the magma becomes more silicic. However, because of loss of volatiles or temperature, a point is finally reached in the cooling mass, where the magma becomes too viscose for convective transfer of heat, and it crusts over. After this has occurred, solidification progresses from the surface down.

Lunar Batholiths

As the lunar batholiths cooled and crusted over, large quantities of basic magma, formed when products of crystal fractioning remelted, were extruded to floor the so-called wet craters and the mares. These extrusives were forced to the surface during the epimagmatic (late) stages by isostatic loading from the growing continents and by pneumatolitic pressures from the cooling and degassing magma. During this stage, polygonal fractures resulting from tensional forces in the cooling crust permitted large areas to be assimilated and engulfed by the rising tide of basic magma. Both piecemeal stopping and cauldron subsidence were active in swallowing up large segments of silicic and primal crust. Slowly, however, the magma reservoirs cooled, and the face of the moon froze into the first-order geomorphic form it displays today.

Meteor strikes and dying volcanism have continued to scar the face of the moon for aeons. Initially, when more meteor material was probably loose in the early solar system, and concentrations of radioactive material in the silicic crust aided dying volcanism, both of these processes must have been very active. However, today even these processes are almost completed and in the history of man only a few observations of possible volcanism or meteor impact have been reported.

In the genesis of the lunar surface outlined here, the early magmatic activity was naturally the most violent, because the moon was then hottest; therefore, the largest craters formed first, and these were subsequently broken into by the smaller and later ones. Also, craters tended to form along lines and zones of weakness of the surface. Thus, the size, distribution, varied shape and structure, geometric arrangement, hill-top craters, elevated light-colored continents contrasting with depressed mares, and many other lunar topographic forms are best explained by assuming a magmatic hypothesis for the genesis of the lunar surface.

Weathering Processes

It seems probable then, that an eruptive-lava complex composes most of the lunar surface and forms the bedrock underlying more recently formed fragmental rocks and meteor dust. Because of the absence of a completed orogenic and weathering cycle on the moon, phanerocrystalline (composed of large crystal grains, *viz* granite) rocks will not be exposed at the surface. These rock textures normally develop deep within the magma chamber under conditions of slow cooling, and they are subsequently exposed at the surface by the forces of weathering and erosion. For the moon, there are several processes of weathering—that is, processes

PROPERTIES	MARIA	CONTINENTS
Rock Type	Igneous with aa-type lava most common. Some pahoehoe and porphyritic types will be evidenced.	Igneous with high vesicular and pyroclastic types common. Some crystalline rocks and vein type deposits will be evidenced.
Composition	Basaltic	Siliceous
Structure	Small-scale irregular but with great continuity of surface. Scarred by numerous meteor impacts.	Very irregular with much fragmentation. Scarred by numerous meteor impacts. Surface transportation will be difficult.
Lunar Dust (7 to 10 cm thick)	Veneers and smooths the irregular vesicular surface. Some dust has been lost into small cracks and openings; thus its thickness here will be from 2 to 5 cm.	The greater irregularity of this surface has concentrated the dust that formed on the sides of steep slopes into thicker deposits.

Table 2. Properties of the lunar surface.

that can bring about the exfoliation, spalling, cracking, pulverization, or general decomposition and disintegration of the lunar surface—but the classical transporting agents of erosion (streams, waves, glaciers, winds and gravity) with the exception of gravity are completely lacking. Thus, phanerocrystalline rocks will not normally be exposed. Instead, the textures of lunar igneous rocks will range from aphanitic (composed of small crystal grains which are made visible through a microscope) or stony through vitreous and vesicular types.

Vesiculation of lava is caused by expanding and escaping magmatic gases and superheated steam, as a result of the decreased pressure of the surface environment. It is a common structure for lava. Rocks characterized by abundant gas cavities are said to be vesicular and are described as porous, frothy, pumiceous, or scoriaceous. Although all extruded lavas, whatever their chemical composition, may under the requisite conditions form vesicular rocks, typical vesicular basalt is called scoriae.

As indicated earlier, the lunar maria are probably composed of basaltic lava flows, comprising two distinct types. These are: first, pahoehoe, which is characterized by sluggishness to flow, a small amount of included gas, and a smooth vitreous surface showing ropy, curved, and billowy forms, and second, block lava or aa, which is characterized by extreme mobility, much included gas, and a vesicular surface that has an irregular blocky form. This latter type is expected to be dominant. Individual flows, as with terrestrial types, should differ greatly in size and thickness; however, each individual flow will be marked by a microvesicular surface that grades downward to form more dense forms of stoney or even porphyritic lava. The total thickness of the series of flows forming the maria will vary because of position relative to the axis of the depression, with only small thicknesses recorded along the flanks of the elevated continental masses. Individual flows, like terrestrial lava flows, will seldom exceed 90 meters in thickness, but the total accrued thickness of lava in the deeper parts of the maria may measure several kilometers.

The higher viscosity of the silica crust formed by differentiation and fractioning in the continental areas, and the protracted degassing which has occurred through this material, has likely resulted in greater vesicular size here than in the maria. In addition, pyroclastic material ejected by volcanoes during the final stages of the lunar magmatic period have contributed to the greater irregularity of these areas. These brecciated pyroclastics have probably formed numerous small volcanic cones and surface deposits that were poorly sorted by the varying force of the volcanic explosion; also, in the absence of a dynamic transporting agent, wide distribution of these materials from their source was not possible. Therefore, even though the total mass of pyroclastic rocks on the moon will exceed the combined amounts formed by all the other lunar weathering agents, they are not evenly distributed, and consequently they will be concentrated into thicker and more localized deposits, thus increasing the large-scale irregularities of the continental surface. For these reasons the elevated continental areas appear lighter in color than the surrounding maria. This lighter appearance is due in part to light-colored rocks, but primarily it is caused by the greater reflectivity of the more irregular continental surface.

The presence of a dust layer covering the lunar surface is suggested from both astronomical observations and theoretical studies (Roy G. Brereton, "Lunar Dust", Aerojet-General Report, 1876, September 1960). In general, the 7 to 10 cm of lunar dust which has accrued on the lunar surface since the end of the magmatic period have tended to smooth the rugged and scarred surrface. Thus, the rough vesicular surface of the maria's aa lava flows and the many small pits from impacting meteorites have been partially filled-in or veneered by fine dust.

AGI International Field Institute participants were photographed as they gathered at Idlewild International Airport on June 29 for departure to London to begin the eight week program of study of classic geologic areas of Great Britain under the field leadership of an outstanding group of British scientists. Pictured above are: 1. John R. Coash, 2. Ansel M. Gooding, 3. Donald W. Weaver, 4. Raymond L. Ethington, 5. Ralph M. Moberly, Jr., 6. Hubert C. Skinner, 7. James W. Valentine, 8. James C. Brice, 9. Donald R. Seely, 10. John A. Fagerstrom, 11. Roger L. Batten, 12. Leo A. Thomas, 13. Daniel B. Sass, 14. Frank D. Holland, Jr., 15. Andrew H. McNair, 16. W. Charles Bell, 17. Chauncy G. Tillman, 18. Donald L. Ballmann and 19. Paul R. Shaffer, Co-director of Institute. Missing from photograph were Marvin J. Andresen and J. Keith Rigby.

JUBILEE CONVENTION

To be staged in Holland April 26-May 3, 1962

The Jubilee Convention organized by the Royal Geological and Mining Society of the Netherlands (1912-1962) and the Geological Survey of the Netherlands (1902-1962) will be held in the Netherlands from April 26 to May 3, 1962.

The plenary sessions of the Convention will take place at Scheveningen, the seaside resort of The Hague; the sectional meetings at Scheveningen and Heerlen. In addition two days will be devoted to visiting various places of interest in connection with the convention subjects of study.

The official theme of the convention will be *Geology and Mining in the Netherlands*. The official language of the meeting will be English although meetings relating to various geological subjects will in part be in German or French. There will be field excursions.

For attending ladies there will be a special program of entertainment by the Ladies Hospitality Committee, "Den Haag Ontvangt", as well as interesting social events connected with the convention.

Interested persons may obtain the convention announcement listing the program and including application forms from the *Secretariat of the Jubilee Convention, 14, Burgemeester de Monchyplein, The Hague, Netherlands.*

Snelgrove Accepts Fulbright

Professor A. K. Snelgrove has been appointed Fulbright lecturer in economic geology at the University of Sind, Nyderabad, West Pakistan for 1961-62. Dr. Snelgrove is head of the Department of Geology & Geological Engineering at the Michigan College of Mining and Technology at Houghton, Michigan.

The University of Sind was established in 1947. In addition to teaching graduate students, Dr. Snelgrove will advise on curriculum matters.

En route to Pakistan, Dr. Snelgrove will attend scientific congresses in Honolulu and Hong Kong, the latter as a guest of the University at its Golden Jubilee celebration, for which he is also invited to give a paper on the geology of lead mines in the new territories of China which he investigated while a Fulbright lecturer at the University.

Geological Engineers Affiliate with AIME

A new Geological Engineering Unit Committee has been established in the Mining and Exploration Division of the Society of Mining Engineers, AIME. The first chairman of this unit committee is Professor Shirley A. Lynch, Head of the Department of Geology and Geophysics at Texas A. & M.

The organization of the new geological engineering group and its affiliation with the AIME has developed out of a series of exploratory meetings held over the past year and a half. Faculty members in the schools where the geological engineering curriculum has been accredited by the Engineers Council for Professional Development have been particularly active in these discussions.

In the new Geological Engineering Unit Committee, Prof. William R. Higgs, Louisiana Polytechnic Institute, Ruston, is head of the Membership Committee. James N. Nielson, Michigan College of Mining & Technology, Houghton, is Chairman of the Program Committee. The Publications Committee is headed by Prof. Parker D. Trask of the University of California, Berkeley.

Prominent Geologists Die

H. R. Gault

H. Richard Gault, Chairman of the Geology Department of Lehigh University died after an illness of several months on July 5, 1961 in Bethlehem, Pennsylvania at the age of 46. In 1953-54 Dr. Gault served as Executive Secretary of the Division of Earth Sciences of the National Academy of Sciences.

Ralph O. Rhoades

Ralph O. Rhoades, prominent geologist-executive who recently retired as Chairman of the Board of the Gulf Oil Corporation, died in mid-July. He played a major role in the discovery of the fabulously rich Kuwait oil field.

Frederick T. Thwaites

Frederick T. Thwaites, 77, long associated with the Department of Geology of the University of Wisconsin and the State Geological Survey died in retirement in Madison, Wisc., in June.

GEOLOGY in the Public Eye

by
Robert L. Bates
Department of Geology, Ohio State University

Early in 1958, shortly after the launching of Sputnik I, a group of scientists and technologists in the Dallas-Forth Worth area met to discuss means of improving the general community's understanding of the problems and activities of science and technology. *Result:* organization of the Council of Scientific Societies, Dallas-Fort Worth Area. Objectives of the Council are (1) to foster among scientists an awareness of their responsibilities in matters of general public interest, (2) to provide a medium for expressing the interests of scientists to the general public, (3) to make available to civic and governmental bodies pertinent information in scientific matters, and (4) to conduct occasional research along these lines. There are 24 member societies. The Council has under way a teacher scholarship program; is actively supporting local science fairs; maintains a speakers' bureau; and is studying problems confronting the local schools. In the spring of 1959, the Council arranged for substitutes for local mathematics teachers, so that the latter could attend the two-day convention of their national association, held in Dallas. Among officers and directors of the Council are geologists/geophysicists R. C. Dunlap, Jr., L. E. English, H. B. Renfro, and N. C. Smith. . . . During the spring of 1961, New York City's New School for Social Research sponsored several courses on *Science for the Layman.* Geology was represented by J. A. Shimer, who reports that he had 20 registrants. Four were teachers; the others were from such occupations as grocer, nurse, technical writer, bookkeeper, attorney, and dancer. Emphasis was on the explanation of scenery. . . . *Geology at the University of Texas* is the title of a sumptuous 38-page booklet recently issued by the department there. It outlines the professional aspects of geology, the training needed, and the personnel and equipment available at Austin. . . . Not long ago the Sunday New York *Times* ran a story on the Lehman Caves National Monument, Nevada. A good story, too—complete with a photograph which was upside down. Can it be that the *Times* make-up man doesn't know a 'tite from a 'mite?

MEMBER SOCIETIES
of the
AMERICAN GEOLOGICAL INSTITUTE
June 1960 Edition

A 16 page booklet which gives data on the organizations, history, purpose, membership requirements, publications, and other pertinent information on the fourteen Member Societies of the American Geological Institute.

Lists present officers of all Societies.

Free on request from

AMERICAN GEOLOGICAL INSTITUTE
2101 Constitution Ave., N.W.
Washington 25, D. C.

AGI LIST OF PUBLICATIONS

AGI has recently published a new list of publications, listing the various journals and other publications published by AGI.

sent free upon request
by

AMERICAN GEOLOGICAL INSTITUTE
2101 Constitution Ave., N.W.
Washington 25, D. C.

DESCRIPTIVE CLASSIFICATION OF METAMORPHIC ROCKS[1]

by
Robert R. Compton
Stanford University

EXPLANATION: In this binomial system for naming metamorphic rocks, the main rock name is based on the texture of the rock, while the principal or more significant minerals are added as modifying nouns, as biotite-quartz schist, andalusite-cordierite hornfels. The names are meant to be applied on a descriptive basis; a schistose rock, for example, should not be called a hornfels because it is found in a contact aureole.

TEXTURES

Schistose-- grains platy or elongate and oriented parallel or subparallel, so that rock cleaves readily. Foliated (lepidoblastic) if fabric is planar, lineated (nematoblastic) if linear.

Granoblastic-- grains approximately equidimensional; platy and linear grains oriented randomly or so subordinate that cleavage is not developed.

Hornfelsic-- grains irregular and interincluded but generally microscopic; recognized in field by unusual toughness, ring to hammer blow, and hackly fracture at all angles to bedding. Under hand lens, freshly broken surfaces show a sugary coating that will not rub off (formed by rending of interlocking grains).

Semischistose-- platy or linear grains subparallel but so subordinate or so unevenly distributed that rock has only a crude cleavage; especially common in metamorphosed granular rocks, as sandstones and igneous rocks.

Cataclastic-- clastic textures resulting from breaking and grinding with little if any recrystallization; characterized by angular, lensoid, or rounded fragments (porphyroclasts) in a fine-grained and commonly streaked or layered groundmass. Mortar structure applies to unoriented arrangements, and phacoidal, flaser, and augen structure apply to lenticular arrangements.

ROCK NAMES

Schistose rocks

Schist-- grains can be seen without using a microscope.

Phyllite-- all (or almost all) grains of groundmass microscopic, but cleavage surfaces have sheen caused by reflections from platy or linear minerals.

Slate-- very cleavable but surfaces dull; tougher than shale and cleavage commonly oblique to bedding.

Phyllonite-- appearance like phyllite but formed by cataclasis and recrystallization of coarser-grained rocks, as indicated by relict rock slices, slip folds, and porphyroclasts.

---

[1] Condensed from Manual of Field Geology, John Wiley and Sons, New York, (In Press).

Additional copies of this data sheet may be obtained from the AMERICAN GEOLOGICAL INSTITUTE. Cost $0.10.

DATA SHEET 27

AGI Data Sheet 27, *Descriptive Classification of Metamorphic Rocks* has been prepared by Robert R. Compton of Stanford University and is condensed from *Manual of Field Geology*, John Wiley and Sons, *in press.*

The AGI Data Sheet Committee consists of the following members: *John E. Allen, William Beatty, Chester Longwell, George Thompson, Ian Campbell, Bob Wallace,* and *Richard M. Foose,* Chairman.

Suggestions for additional data sheets are welcomed by the Data Sheet Committee and should be forwarded to *Dr. Richard M. Foose, Earth Sciences Division, Stanford Research Institute, Menlo Park, California.*

A complete list of all AGI Data Sheets may be obtained by requesting the AGI List of Publications. Write: *Publications, American Geological Institute, 2101 Constitution Ave., N.W., Washington 25, D.C.*

Granoblastic rocks

Granulite or granofels-- granoblastic rocks, irrespective of mineral composition; because granulite can connote special compositions and conditions of origin, granofels may be preferred.

Quartzite, marble, and amphibolite-- compositional names that generally connote granoblastic texture; exceptions should be modified for clarity, as schistose amphibolite (or plagioclase-hornblende schist).

Tactite (skarn)-- heterogeneous calc-silicate granulites and related metasomatic rocks of typically uneven grain.

Hornfelsic rocks

All called hornfels, or, if relict features clear, hornfelsic may be used with the original rock name (as hornfelsic andesite).

Semischistose rocks

Semischist-- fine-grained (typically less than 1/4 mm) so that individual platy or lineate grains are indistinct; relict features often common.

Gneiss-- generally coarser than 1/2 mm with small aggregates of platy or lineate grains forming separate lenses, blades, or streaks in otherwise granoblastic rock. Platy or lineate structures may be distributed evenly through the rock or may be concentrated locally so that some layers or lenses are granoblastic or schistose (banded gneiss).

Cataclastic rocks

Where original nature of rock is still apparent, rock name can be modified by suitable adjectives (as cataclastic granite, flaser gabbro, phacoidal rhyolite).

Mylonite-- crushing so thorough that rock is largely aphanitic and commonly dark-colored; may be layered and crudely fissile but not schistose like phyllonite; porphyroclasts commonly rounded or lenticular.

Ultramylonite, pseudotachylite-- Aphanitic to nearly vitreous-appearing dark rock typically injected as dikes into adjoining rocks.

Relict and special textures and structures

If textures of low-grade metamorphic rocks are dominantly relict, original rock names may be modified (as massive metabasalt, semischistose meta-andesite). If hydrothermal alteration has produced prominent new minerals, names such as chloritized diorite and sericitized granite can be used.

Strongly metasomatized rocks with coarse or unusual textures may require such special names as greissen, quartz-schorl rock, and corundum-mica rock.

Migmatite-- mixtures of metamorphic and igneous-appearing rocks, especially of granitic veins and pods in a metamorphic rock host. Because of variety of types and variable usage of the term migmatite, these rocks might better be given such descriptive names as veined biotite schist, feldspathized quartzite, and injected gneiss.

GEOTIMES

INDEX

July 1956 to May-June 1960

Volumes I-IV

$1.00

Send payment with order

AMERICAN GEOLOGICAL INSTITUTE
2101 Constitution Ave., N.W.
Washington 25, D. C.

Now in 1960 . . .

MINERAL FOSSIL & ROCK EXHIBITS

. . . and where to see them

A directory of 167 U. S. and 12 Canadian museums, large and small, with significant geological exhibits.

A big help to the amateur rock hound and also to the professional geologist.

Price $0.50

Send payment with order to

AMERICAN GEOLOGICAL INSTITUTE
2101 Constitution Ave., N.W.
Washington 25, D. C.

GSI Student Program

Students from thirteen universities participated in the 11th Annual Student Cooperative Program sponsored by Geophysical Services Inc. A four-day orientation session in June afforded the 18 participants an opportunity to learn more of the research frontiers in the field of geophysics from leaders in research and industry. Subsequently the participants were assigned to GSI field crews and the research department for summer on-the-job experience.

New Bolivian Geological Society

The Sociedad Geológica Boliviana was organized in March 1961 with a membership of approximately 70 geologists. Gustavo Donoso, Director of the Departamento Nacional de Geología, is President and Henry Meyer is Secretary. The first number of a mimeographed news letter entitled Noticiero de la Sociedad Geológica Boliviana was issued in May. The Society's address is *Edificio Minminas, 4º Piso, Casilla 2729, La Paz.*

COMMITTEE OF 1000 for AGI in 1961

Now has 1143 members

Ideally the American Geological Institute should be supported by a modest, but uniform assessment on all geological scientists holding membership in Member Societies of the Institute. A sum of $3 to $5 per year per individual would provide AGI an amount in excess of $60,000 to provide for the basic operations of the Institute and for GEOTIMES. Unfortunately such an ideal solution to AGI's basic financing has not been realized in the past nor is it likely to be realized in the near future. Member Societies currently contribute a sum equivalent to about $1 per geological scientist, so that other financing from individuals must be sought.

The 1143 contributors to the Committee of 1000 through their contributions of $10 or more have provided a most important segment of supplementary funds to meet AGI's 1961 expenses.

Recent additions to the Committee of 1000 for AGI-1961*

Gilles O. Allard	Earl Ingerson
Robert W. Anderson	H. M. Kirk
John L. Baum	A. La Rocque
John H. Brineman	Edward Leith
W. A. Broughton	Julian W. Low
Lois J. Campbell	George C. Lutz
C. W. Cargile	J. E. McCall
Grace M. Carhart	C. Richard Maise
Joan R. Clark	Michigan State University Sigma Gamma Epsilon
Lawrence C. Craig	
James I. Culbert	Frederick K. Morris
William L. Daoust	Roderick G. Murchinson, Jr.
Clyde S. Deal	University of Oklahoma Sigma Gamma Epsilon
John G. Douglas	
John C. Dunlap	Charles Danfield Reynolds
Robert L. Fuchs	Thomas G. Roberts
H. F. Garner	John F. Rollins
Gordon C. Grender	Robert W. Schnabel
Mona D. Guiler	H. L. Spyres
K. Habicht	Thomas E. Stephenson
William B. Hall	Blair W. Stewart
W. Dow Hamm	Frank A. Swenson
Allen G. Hatley	C. J. Vitaliano
Adolf U. Honkala	Dorothy B. Vitaliano
A. P. Hornor, Jr.	S. E. Watson
Arthur D. Howard	William J. Waylett

* Listed here are 50 contributors to the Committee of 1000 for AGI-1961 since the last published list appearing in the July-August issue of GEOTIMES. Previous lists also appeared in the March-April and May-June issues.

INTERNATIONAL CONFERENCE ON PALYNOLOGY

Tucson, Arizona
April 23-27, 1962

In 1962 a conference dealing with modern and fossil pollen and spores and related micro-organisms will be held at the University of Arizona in Tucson. The purpose of the conference is to bring together scholars in *all* phases of palynological research and to discuss problems important to all of them. The program is subdivided into the following sections:

A. Stratigraphic Palynology (Proterozoic-Cenozoic)
B. Evolution and floristic affinities
C. Morphology and Taxonomy
D. Prehistory and Archaeology
E. Aerobiology
F. Melittopalynology
G. Ecology, Paleoecology, and Paleoclimatology
H. Microscopic Algae and related forms (Hystrichospharoids, Chitinozoans, Diatoms, etc.)
I. Techniques and data processing

The following symposia and round-table conferences are planned:

1. Early plants
2. The Pennsylvanian–Permian boundary and the limits of the Gondwana System
3. Evolution of gymnospermous plants and Mesozoic Stratigraphy
4. The Cretaceous–Tertiary boundary
5. Pleistocene
6. Taxonomy of living plants
7. Morphology
8. Morphologic Terms used in Palynology
9. Nomenclature
10. Cataloging and International organization

More than 300 palynologists from all over the world have already indicated their desire to attend the conference. This list includes scientists from 34 different countries including Russia, India, Japan, and most of the European countries.

Scientists who plan to attend the conference should send in the titles of their proposed papers not later than October 16, 1961; abstracts must be filed before January 2, 1962, and proposals to be discussed at the round-table conferences before December 1, 1961. All correspondence should be sent to: *International Conference on Palynology, Geochronology Laboratories, University of Arizona, Tucson.*

John de Sisto, left, was recently elected president of the Venezuelan Geology, Mineral & Petroleum Association and succeeds **D. J. Shriner,** right.

The new officers of the Association Venezolana de Geologia, Mineria y Petroleo are: J. de Sisto, Mene Grande Oil Co., President; H. Young, Sun Oil Co., 1st Vice-President; Ian MacArtney, Pan-Ven, 2nd Vice-President; G. W. Trump, Creole, Regional Vice-President for western Venezuela; F. Smith, Jr., Mobil Oil Co., Regional Vice-President for eastern Venezuela; Charles Jefferson, Jr., Independent, Secretary-Treasurer; R. Burrows, Sinclair Oil Co., Assistant Secretary-Treasurer; P. W. Taylor, Caracas Petroleum Co., Editor.

Study-Research Opportunities in Soviet Union

Since the beginning of Soviet-American exhange programs in September 1958 under the Inter-University Committee on Travel Grants, 66 American graduate students and young faculty members in the sciences, social sciences and humanities have spent periods ranging from five months to two academic years in the Soviet Union and 38 others are scheduled for visits during the coming academic year. The program has also provided for Soviet students studying in this country in exchange. Several of the Americans have pursued academic studies and research in geology.

American citizens under forty years of age are eligible for participation in this program if they are graduate students, post-doctoral researchers or faculty members at the time of application. Filing date for applications for the 1962-63 exchange is December 15, 1961. Further information and applications may be obtained from: *Stephen Viederman, Deputy Chairman, Inter-University Committee on Travel Grants, 719 Ballantine Hall, Indiana University, Bloomington, Indiana.*

MANPOWER *in a column —*

By HOWARD A. MEYERHOFF
Scientific Manpower Commission
1507 M Street, N.W., Washington 5, D. C.

The July induction call for men for military service in the Army was 8,000. It was 13,000 for August. All spring it was about 1,500 a month.

Although 200,000 calls in a year will put no strain on the pool of manpower available for service, it does mean that men who have gambled on a I-A classification are working against higher odds. The chances of getting by to age 26 without donning a uniform are only 18.5% as good as they appeared three or four months ago.

The widespread fear of incurring extended military liability to age 35 by seeking a deferred classification is baseless, anyway.

Deferment establishes several facts:

- For scientists and engineers it demonstrates that they possess the advanced training and/or experience that give them "critical occupations" in time of emergency.
- Deferment is also an official record of the fact that the man deferred is engaged in an "essential activity" and should not be drafted without a review of his status in the light of military and civilian needs in a period of stepped-up mobilization. The men deferred have status; the men in 1-A have none.

Perhaps, by the time this column is printed, the Berlin crisis and the military threat it poses will have become clear. At the time it is being written, however, even Selective Service officials have no authentic information as to the outlook for a continuing increase in call-ups. They are responding to the fact that more men are being drafted by calling many more for physical examinations.

As General Hershey explained it to the press, "Suppose I invite a friend to lunch. I must draw money from the bank to pay for it, and how much will I draw? I don't know where or how much he will choose to eat, but I have to have enough to pay. Well, I propose to have enough men available for service to meet any volume of calls the Armed Services may make."

This is about as close as we can come to explaining what is going on at present, or predicting what is to come.

Hubbert at Stanford

M. King Hubbert will teach a course in the "Physics of Underground Fluids" in the school of Mineral Sciences at Stanford University during the winter quarter in January-March 1962. Dr. Hubbert, the guest professor, is affiliated with the Shell Oil Company. He is Vice-President of the Geological Society of America.

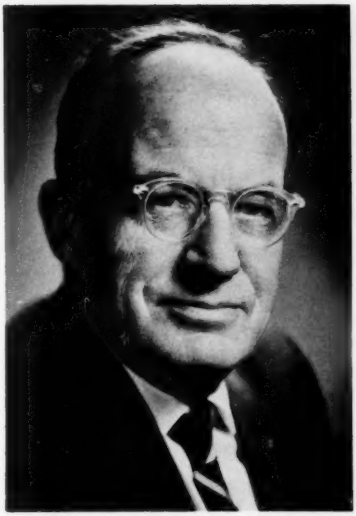
GEOLOGY AND ENGINEERING

It is gratifying to observe the growth of engineering geology, and disturbing to note its inevitable growing pains. Diverse opinions regarding the basic responsibilites of the engineering geologist will continue to plague the profession.

The practical solution is by no means as complex as is the human reaction to it. Few people will disagree that the engineer is and must be directly responsible for the planning, design, and construction of any engineering feature or structure. It may be unfortunate that academic engineering training tends to neglect geology, but the lack of such training in no way reduces the encumbent engineer's overall responsibility. It merely increases his risk. The word risk may be unpopular, but it exists nevertheless in spite of technical advancements. Geologic training is the best and perhaps the only method of bringing an engineering awareness of the engineering risk factors inherent to normal geologic diversity.

Engineering geologists obtain, interpret, and evaluate these diverse geologic factors, making appropriate engineering recommendations; but they are not and cannot be entirely responsible for its utilization. This basic fact seems to trouble some geologists, who believe there should be some "back door" entrance to the engineering profession. There is not. Some geologists may be competent engineers and some engineers may be competent geologists; but competency cannot be confused with responsibility in any organized endeavor. Informed engineers fully utilize geologic data, those perhaps less informed merely increase their individual risk. This solution in no way reduces the stature of the engineering geologist; it is, rather, a challenge to broaden his engineering acceptance.

[1] Reprinted in part from comments by Mansfield Merriman appearing in the CAEG Newsletter, vol. 4, no. 2, January 1961, published by the California Association of Engineering Geologists.



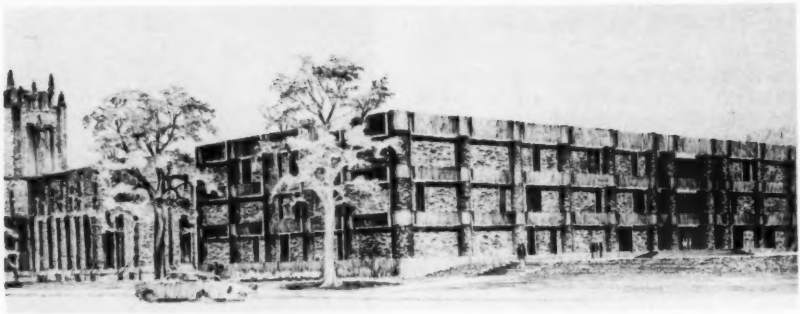
Joseph L. Gillson, recently retired Chief Geologist of the DuPont Company, will be the first **William Otis Crosby** Lecturer at the Massachusetts Institute of Technology during the year 1961-62. He will lecture on industrial minerals.

Dr. Gillson is a past president of the American Geological Institute (1957), Society of Economic Geologists (1959), and the A.I.M.E. (1960). In 1957 he was designated for A.I.M.E.'s Jackling Award.

A William Otis Crosby Lectureship in Geology has been established at M.I.T. as a memorial to one of its earliest geology graduates (Class of 1876), who, after graduation, returned to teach for more than thirty years (1875-1907).

Hewitt Named New Utah State Geologist

Dr. William P. Hewitt has been appointed by the Board of Regents of the University of Utah as Director of the Utah Geological and Mineralogical Survey. He has also been appointed Professor in the Department of Geology, University of Utah, where he will serve half-time and each courses in economic geology. He succeeds Arthur L. Crawford, and assumed office on July 1. Mr. Crawford will continue with the Survey as Assistant Director. Dr. Hewitt, until recently, was senior geologist of the Western Mining Department of the American Smelting and Refining Company, and has had an extensive experience in the exploration for minerals in Mexico and the western United States.



The Department of Geology at Yale University is to have a new $3.5 million building which will be known as the Kline Geology Laboratory after C. Mahlon Kline of Philadelphia who is honorary chairman of Smith, Kline and French, the pharmaceutical firm, and a graduate of Yale's Sheffield Scientific School. A total gift of $10 million by Mr. Kline will provide for new buildings for geology, chemistry, the biologigal sciences and a central auditorium for the sciences. A grant of $400,000 from the National Science Foundation will contribute toward equipping the laboratory facilities in the new building which will be started late in 1961.

Columbian Society Field Guide Books Available

Twenty-five geologists and geophysicists of the Colombian Society of Petroleum Geologists and Geophysicists attended a two-day field excursion to the 400-year-old world-famous Muzo emerald mines on March 25 and 26. The trip also included discussions of the Lower Tertiary and Upper Cretaceous of the western portions of the departments of Boyacá and Cundinamarca. Guide books are available for US $3.00 from the *Colombian Society of Petroleum Geologists and Geophysicists, Apartado Aéreo 11662, Bogotá, Colombia.*

New Geological Society in Northern Ohio

The Northern Ohio Geological Society was officially organized on May 9, 1961. The following were elected as officers:

President—D. R. RICHNER, Diamond Alkali Co., Cleveland, Ohio

Vice President—JOHN F. HALL, Western Reserve University, Cleveland, Ohio

Secretary—T. H. HAWISHER, Ferro Corp, Cleveland, Ohio

Treasurer—R. B. SITLER, Kent State University, Kent, Ohio

In addition to providing a geological forum for its members, the Society is working to promote increased public interest in the earth sciences. A full schedule of meetings, programs, and field trips has been arranged for the coming year.

Information regarding membership in the Northern Ohio Geological Society may be obtained by contacting *Mr. Glenn Frank, 7446 West Lake Boulevard, Kent, Ohio.*

Philadelphia Geological Society

The Philadelphia Geological Society was recently formed by geologists in southeastern Pennsylvania and adjacent areas of New Jersey and Delaware. The membership in the society is approaching one hundred. The new society has met enthusiastic response and its meetings have been well attended. At the third meeting of the society the Swiss geologist, Professor Augusto Gansser, one of the participants in the AGI Visiting International Scientist Program, was the guest speaker. In May a New Jersey Coastal Plain field trip was led by Dr. Horace Richards.

Officers of the Philadelphia Geological Society include President, Kalman N. Isaacs of Aero Service Corporation; and Secretary-Treasurer, Dr. Horace Richards of the Academy of Natural Sciences. The executive committee consists of Ronald R. Hartman of Aero Service Corporation, who first envisioned the Society and did much of the initial organizational work; Dr. Edward Watson of Bryn Mawr College; Dr. Robert Fulton of duPont de Nemours Co.; Dr. Carlyle Gray of the Pennsylvania Geological Survey and Dr. Jorma Kalliokoski of Princeton University.

INTERNATIONAL VOLCANOLOGY SYMPOSIUM

Japan
May 9-19, 1962

The first circular has been distributed for the International Symposium on Volcanology, Tokyo, Japan, May 9-19, 1962. The meeting is being organized by the Science Council of Japan in cooperation with the Volcanological Society of Japan under the sponsorship of the International Association of Volcanology (IAV) of the International Union of Geodesy and Geophysics (IUGG).

The Symposium program will center around discussion of 1. Prediction of time and place of volcanic eruption and 2. Relation between magmas and the nature of volcanic eruptions. Two field trips will be arranged during the Symposium period and post-meeting trips are scheduled to three volcanic areas: Kyusyu Islands (5 days), Hokkaido Island (5 days) and O-sima Volcano (3 days).

First Circular
International Symposium
on
Volcanology

Available on request from the
AMERICAN GEOLOGICAL INSTITUTE
2101 Constitution Ave., N.W.
Washington 25, D. C.

Chairman of the Organizing Committee is Kiyoo Wadati and the Secretaries are Hisashi Kuno (one of AGI Visiting International Scientists in 1961), Takeshi Minakami, Akira Suwa and Katsumi Watanabe.

Inquiries should be addressed to *Secretary, Organizing Committee, International Symposium on Volcanology, Science Council of Japan, Ueno Park, Tokyo, Japan.*

Geophysicists Award Scholarships

The Society of Exploration Geophysicists, through the SEG Foundation, has awarded scholarships to Murli Manghnani and Roger M. Stewart. Manghnani, a native of West Pakistan, is completing work on his Ph.D. in geology at Montana State University and will enter Washington University in St. Louis. Stewart will study geophysics at the University of California.

Charles V. Theis is joining the staff of the Department of Geology at Columbia University as Adjunct Professor of Geology, 1961-62. Dr. Theis, for over 30 years associated with the Water Resources Division of the U. S. Geological Survey, will teach a graduate course in fundamental principles of ground water geology and will conduct an advanced seminar for graduate students specializing in geohydrology.

Antarctic Programs Office Established by NSF

An Office of Antarctic Programs has been established within the National Science Foundation under the direction of Dr. Thomas O. Jones in response to the growing importance of scientific research in Antarctica. The new office will have responsibility for the United States Antarctic Research Program (USARP) which embraces all U. S. scientific work carried out at the South Pole.

Major Antarctic research programs are maintained by the University of Wisconsin, the U. S. Weather Bureau, Ohio State University, the U. S. Geological Survey, Stanford University, the U. S. Coast and Geodetic Survey, Bartol Research Foundation, the American Geographical Society, and the University of Michigan.

New institutions have been brought into the work, and projects by individual investigators or teams working on specific problems have been encouraged. During the past year, for the first time, this type of project received the largest proportion of funds available for scientific work in Antarctica.

Popular Geology in print

by Mark W. Faugborn, Jr.

Two lively new volumes suitable for the high school student and uninitiated adult are *Patricia Jahns'* MATTHEW FONTAINE MAURY & JOSEPH HENRY, SCIENTISTS OF THE CIVIL WAR (Hastings House, 1961, $5.95) and *Val Gedron's* THE DRAGON TREE, A LIFE OF ALEXANDER, BARON VON HUMBOLDT (Longmans, 1961, $3.95). Miss Jahns' gossipy double biography traces the lives of the first oceanographer and his brilliant Yankee rival, Henry, pioneering physicist and head of the Smithsonian; her insights into politics-ridden Federal science in mid-nineteenth century Washington may make a lot of readers want to dig further; the good bibliography will help them to do just that. In her brief biography of Humboldt, Miss Gedron brings to life the rather austere figure of the Goettingen-trained geologist and scientific explorer, last of the great universal geniuses; brief bibliography.

Louis Agassiz has been the subject of several biographies in reecnt years. Among the best is *Louise Hall Tharp's* LOUIS AGASSIZ: ADVENTUROUS SCIENTIST (Little, Brown, 1961. $3.75), in which the life of the Swiss-born glaciologist, zoologist, and famed Harvard teacher is charmingly portrayed for ages 12 to 15. "Cabin boy Dick Covington" and Darwin are the chief characters in WE WERE THERE WITH CHARLES DARWIN ON H. M. S. BEAGLE, by *Philip Eisenberg* (Grosset, 1960, $1.95), an enjoyable and informative fictionized account of the great voyage, and just the thing for youngsters 10 to 13.

Of more interest to adult layman and scholar is *Maurice M. Vance's* CHARLES RICHARD VAN HISE, SCIENTIST PROGRESSIVE (Madison, Wisconsin State Historical Society, 1960, $6). Van Hise, the great expert on metamorphics, was president of the University of Wisconsin from 1903 to 1917, and pioneered extension services and other innovations; even if Van Hise's vigorous personality seems a little pale, this is a readable and scholarly study, with extensive bibliographical notes.

Intended for older children, but so straightforwardly written that it will also appeal to adults, is *Herbert S. Zim's* brief ROCKS AND HOW THEY WERE FORMED (Golden Press, 1961, $.69). After generalities and a review of the rock-forming minerals the author describes the chief rocks and tells how they are formed, and concludes with a chapter on the uses of rocks and minerals; the abundant illustrations, all in color, are generally fine, and as in most Zim books, are well tied to the text; no bibliography. Another little appreciation book, this one for ages 8 to 12, is WONDERS OF ROCKS AND MINERALS (Dodd, Mead, 1961, $2.95), in which mineralogist *Richard M. Pearl* describes the nature, origins, and uses of some interesting rocks and minerals, and then briefly suggests how to collect them; illustrations and bibliographic notes are not up to this experienced popularizer's usual standards.

Columbia Expedition to Nile

A Columbia University joint anthropology-geology expedition will explore the Nubian sector of the Nile Valley in search for the missing link between the very primitive man of Africa and the ancient man of Europe.

The leaders of the expedition will be Dr. Ralph Solecki, associate professor of Anthropology at Columbia, and Dr. Rhodes W. Fairbridge, professor of Geology at Columbia.

Professor Fairbridge plans to leave with his group on August 1 and will remain until February. Dr. Solecki, who will direct the anthropological work, plans to leave in December. The work is being supported by a grant of $38,500 by the National Science Foundation. The government of the Republic of Sudan and the United Nations Educational, Scientific and Cultural Organization are cooperating in the project.

The research will be carried on in the neighborhood of Wadi Halfa, a town on the Nile in Northern Sudan just south of the Egyptian border. It is the terminus of the railroad from Khartoum, and a transfer point for goods to steamers going down the Nile to Egypt. Ancient ruins are nearby.

The Columbia expedition is part of an extensive plan to save relics threatened by the Nile waters that will rise behind the Aswan High Dam. Only recently the United Arab Republic approved an Italian plan to save two 3,200-year-old temples built by Rameses II at Abu Simbel in Egyptian Nubia. This overall project, estimated to cost $70,000,000, would raise the massive stone structures 186 feet to a safe spot on the granite hills of the Nile's eastern bank. Rameses reigned from 1292 to 1225 B.C.

Jersey Production Builds New Observatory For Geologic Studies

Jersey Production Research Company, Tulsa based research affiliate of Standard Oil Company (N. J.) and Humble Oil & Refining Company, has started construction of a specially designed Earth Sciences Observatory near Leonard, Oklahoma, about 20 miles southeast of Tulsa.

This unique installation will allow simultaneous measurement of naturally occurring events in the earth's crust. Some of these phenomena are known to be correlatable, while others are thought to be related. Therefore, it is believed that simultaneous recording and subsequent search for relationships between such events will lead to additional fundamental knowledge and understanding of the processes governing earth crust phenomena.

The new Observatory will enable Jersey Production Research scientists to study such things as local and distant earthquakes, earth tides, earth tilt, geomagnetic field variations, and earth current fluctuations. In addition, selected prominent earth scientists from universities and other scientific institutions will be invited to use the facilities of the Observatory in conducting their independent research.

The installation will include a subsurface vault in which delicate instruments will be mounted on a concrete pier set in bedrock located about 17 feet below the surface of the earth. This underground arrangement will aid in shielding the instruments from unwanted disturbances and will permit close temperature control.

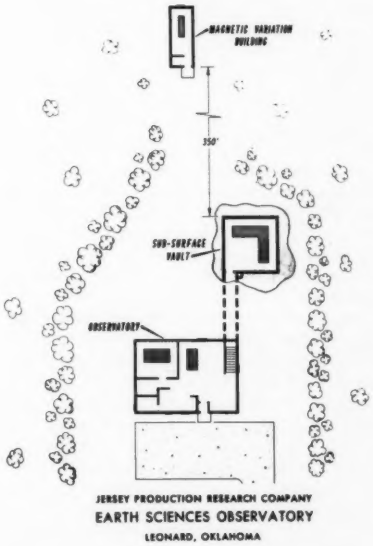
Several factors governed the selection of the site. The principal criteria were freedom from man-made seismic and electrical disturbances, reasonable depth to massive bedrock, ample area for electrical potential spreads, and proximity to the Jersey Production Research Company's Tulsa Research Center and its data handling facilities.

Most of the instruments have been delivered and it is anticipated that the Observatory will be completed and in partial operation by the latter part of this summer. As part of the research work to be conducted at the site, several holes will be drilled to depths of 2,000-3,000 feet for the purpose of emplacing instruments.

Other Jersey Production Research Company equipment is being operated in a mine in northern New Jersey as a supplement to extensive studies of earth crustal movements that are being carried out by the Lamont Geophysical Observatory of Columbia University in cooperation with the New Jersey Zinc Company.

F. G. Boucher, Jersey Production Research senior research associate in charge of the Earth Science Observatory, recently reviewed plans for the installation at an informal meeting of section presidents and others at the annual meeting of the American Geophysical Union in Washington, D. C.

Jersey Production Research Company Earth Sciences Observatory near Tulsa, Oklahoma, under construction. Top of underground vault in foreground. Observatory building in background. Piers are for placement of the instruments. Piers are set in bedrock and are not connected to building foundation.



Report by WAKEFIELD DORT, JR., *Member, AGI Visual Education Committee.*

The AGI Visual Education Committee is grateful to those individuals who replied to their recent Film and Film Strip Review questionnaire and thereby materially assisted the work of the group. Replies were received from 41 teachers representing 34 institutions. Six schools, including three "big" ones, reported that they used no films. The rest recommended a total of 88 films, of which 41 were named by only one person. The most popular films, in order of frequency of mention, are:

In the Beginning. *Socony*
Fossil Story. *Shell*
Geological Work of Ice. *EBF**
Ground Water. *EBF**
Kilauea Eruption of 1955. *USGS*
Mountain Building. *EBF**
The Bahamas. *Humble*
Wearing Away of the Land. *EBF**

Many of the films recommended were simultaneously damned by faint praise or by calls for revision or outright replacement. It was clearly indicated that many of the films are distinctly unsatisfactory, but are used because there is nothing better available.

Suggestions for new films were freely offered. The wide diversity of subjects is a measure of the great need felt by those who teach. New and improved films were requested in ALL fields of geology. Special emphasis was given by respondents to the need for higher standards of presentation and, especially, narration. "Practically any topic treated at a sophisticated level." "Much more narration above the kindergarten level." Specific requests were made for films showing details of geologic processes, regional geology, and field methods, research techniques, and the basis for formulation of geological interpretations. The committee will use these suggestions as a guide during attempts to promote new educational films.

Work on the revision of the *Directory of Films of Possible Interest to Geologists* is proceeding rapidly. It will probably contain descriptions and evaluations of more than 500 films. Extensive cross-referencing will be provided.

*Encyclopedia Britannica Films

TEKTITES—*Continued from page 12*

Archaeology, of the University of the Philippines. Most of these were amassed from areas now built over by the expanding city, but some are still collected. Dr. Beyer has a system by which he pays the land owners for the tektites they collect from their small plots of ground. Once or twice a year he makes the rounds gathering the crop. We accompanied him on two of these excursions.

Mr. Joseph Harrington and Mr. Darwin Rossman, U. S. Geological Survey geologists with the International Cooperation Administration, gave us much help and moral support during our stay in the Philippines, as did the Philippine Bureau of Mines. On a trip to Cabarruyan Island with Mr. Oscar Crispin of the latter organization, and guided by Eusebio de Castro, Dr. Beyer's collector in this area, I found two specimens. Neither was *in situ*, and since the primary purpose of the trip to the Philippines was to determine the geological occurrence of philippinites I felt a degree of frustration. However, the time we spent in the Philippines was rewarding in many other ways. Dr. Beyer gave me 506 specimens which I am examining, and eventually material from the Beyer collection may help solve the tektite problem.

Still to be examined in the field are: (1) The occurrence of tektites in the Ivory Coast to see if they are related to a crater-like feature in Ghana. (2) the occurrence of Libyan Desert glass in Egypt to see if it is related to a group of craters to the south. (3) The occurrence of glass and the absence of meteoritic material around the Aouelloul impact crater in Mauretania. And (4) the occurrence of maucasanite in Peru, a peculiar glass which is high in alumina and contains alumina minerals such as andalusite and sillimanite.

The Peruvian glass will soon be investigated, and the writer hopes to examine the Ivory Coast tektite occurrence. However, field investigations of the more inaccessible spots such as the Libyan Desert may not be possible within the time limits of this project. The samples and data already collected, when processed, may well provide sufficient evidence to prove whether tektites are extraterrestrial or whether they formed here on earth.

DEAR SIR:

Please find enclosed a cheque, constituting my contribution to AGI. I realize that AGI's role in advancing geology and in stimulating activities in our beloved profession is important indeed.

Yours sincerely,

L. RITSEMA
Profondeville, Belgium

DEAR SIR:

It is with deep regret that I cannot contribute more to the AGI at this time. However, my present employment is rather small salaried.

I would like you to know how much I appreciate receiving the GEOTIMES.

To a person such as myself, who is temporarily out of touch with either the academic or industrial phases of geology, your little publication provides the only available means of keeping in touch with the less technical side of the science.

I hope that your magazine grows in proportion to the job that it is doing.

Sincerely,

ROBERT A. MICHELSON Sp/4
A.B. Geology, Harvard '59
USARAL Spt. Cmd.
APO 949, Seattle

DEAR SIR:

Your roseate article on the Mohole project in the May-June issue of GeoTimes appears to be a bit exaggerated.

"They said it couldn't be done . . ." it is captioned. Then it proceeds to hail the completion of some three preliminary holes to superficial depths in the ocean floor, as though the Mohorovicic discontinuity had actually been reached and penetrated. This is like comparing a honeymoon with a golden anniversary. . . .

"Ironically for the critics of the Mohole Project, this important contribution to geologic knowledge (recovery of vesicular basalt) came on April 1," your article states. It is indeed ironic, but not for the critics, of whom I am one. The irony is that submarine "vesicular basalt" was immediately and publicly hailed as constituting the "second layer," etc., and makes one wonder who is being April-fooled by whom.

The Mohole project to date has undoubtedly been beneficial. For one thing, it has initiated some of our swivel-chair scientists into the mysteries of rotary drilling, which in itself should open new vistas to them. They have also learned about offshore operating and got some good fresh air, apparently without losing a man nor getting seriously hurt. This is indeed progress.

But somewhere along the line it would be encouraging to see a little less concern with publicity and overwrought, overdirected photographic essays in Life Magazine, and a little more attention to the actual, uninflated value of what has been accomplished for the millions of dollars expended in comparison with all the other worthwhile frontiers of geologic research.

"They said it couldn't be done." Who said this first phase couldn't be done? It was merely the extension, with government money, of work for which CUSS #1 was designed. The third phase, penetration of the Moho, lacks a good deal of being done, including the expenditure of many millions of dollars of tax-raised public money, which outside of Washington is still important. Until you actually hole the Moho, I suggest you avoid going overboard, regardless of the depth of the water, and try to maintain some sort of reasonable perspective. Worthwhile geological objectives deserve more than the "miscellaneous," sensation-seeking approach, and a little consideration of the maximum amount of bonafide *geologic* information obtainable per dollar expended.

Very truly yours,

FRANK B. CONSELMAN

DEAR BOSS:

Those Chairmen of Departments of Geology in the colleges and universities deserve a pat on the back for their frequent and prompt assistant to AGI. For instance, it was good to be able to report on 100 per cent of the departments in this year's survey of the student population (*"Pendulum Swinging too Far?"* in May-June *GeoTimes*).

Now that we're revising the Directory of GeoScience Departments, they are sending in the new material on staff and curriculum at a good rate for the 1962 edition that will be ready in the fall. And I'd like to report that they have been distributing Earth Science Register question-

naires to their graduating seniors and graduate students. As of today, we have received completed forms from 400 students scattered over the United States in 108 different colleges and universities. Thanks again to the Department Heads!

MRS. BONNIE HENDERSON

AGI Supervisor,
Earth Sciences Register

DEAR EDITOR:

Apparently it is becoming increasingly popular to distort the usage of what should be a perfectly unambiguous symbol. I refer to the ±. As an example, one needs look only as far as a recent Bulletin of the Geological Society of America, Vol. 71, no. 11, p. 1607, where the following appears: "Clots may be single, nearly equidimensianol plagioclase crystals (± 1 cm) or clusters . . ." Even I have seen + 1 cm. plagioclase crystals, yet the − 1 cm. variety have so far escaped detection.

In an analagous case, somebody recently measured the distance between two points as ± 30 km. Using a map, I was able to determine the distance as 30 km. ± 2 km, quite a bit better than the other chap.

Obviously, logically, and sensibly, the ± should be placed after the measurement and the limits specified. For any median or average value of a series of measurements, elementary statistical treatment will show what limits are applicable.

Sincerely,

NOEL W. HINNERS
Princeton, N. J.

DEAR EDITOR:

I was disappointed to read in a recent issue of the Oil and Gas Journal a statement by a prominent geologist referring to geology as not an "exact" science. Reading further it became obvious that he was speaking of 'applied geology' not of the basic science. Nevertheless, it brought to mind an old and pointless distinction. Is geology an exact science? The question may be worthy of argument for semantic reasons only, but that is a pastime for sophomores.

It seems to me that those who insist on classifying a particular discipline as "exact" or "not exact" fail to perceive that such classification is not significant. A more important distinction between science is the degree of abstraction. The great utility of mathematics and logic, the most abstract sciences, stems from their abstract nature and their application to an infinite number of concrete problems. As Herbert Spencer pointed out, physics and chemistry are less abstract, more concrete, than are mathematics and logic. Even more concrete are sciences of geology, biology and astronomy. Nevertheless, all are important and "exact" sciences.

Any science is knowledge amassed, severely tested, coordinated and systematized. The amassing of knowledge is accomplished by collecting data through experimentation, observation, measurement, and the recording of events, followed by the interpretation of data collected. The interpretation of data is subject to human error. To say that scientists in one field are less prone to err, and therefore more "exact", than are those in another field is nonsense.

Our desire as scientists should be to progress from the concrete to the abstract so that we may formulate generalizations, or laws of nature, which then can be applied to specific problems wherever and whenever they arise. At present geology has not the broad base required for its development as an abstract science. On the other hand, the other more abstract sciences are fundamental tools in the study of geology.

Sincerely,

R. W. LAWSON
Mobil Exploration, Ankara Turkey

ANTARCTIC RESEARCH

(Continued from page 17)

Base Pedro Aguisse Cerda (Deception Island) recent volcanics consisting of agglomerate, red and black scoriaceous basalts, aphanitic and porphyritic basalt and ropey basalt lava. The volcanics dip into Port Foster, the crater formed by several phases of volcanic activity.

Base Bernardo O'Higgins (approx. Lat 63°20′S., Long. 57°50′W.) geology of the base is one of alernating metagraywacke and phyllite cut by thin quartz veins which conform with and transect the relict bedding planes. Attitudes 060° at 50°NW.

During the 1961-62 austral summer, Dr. R. H. Dott, Jr., principal investigator under the National Science Foundation supported grant, will accompany the field party to Base Bernardo O'Higgins where detailed mapping will be confined to the offshore islands to increase our knowledge of the sedimentary and tectonic history of this region of Antarctica.

AAPG Grants-in-Aid Offered

The American Association of Petroleum Geologists has announced the continuation of its Grants-In-Aid program for the support of research in fields of general interest to petroleum geologists. In selecting research to be supported, emphasis will be placed on the development of new principles as contrasted to data-gathering or problem-solving techniques.

The grants will be limited to $1500 or less and will not provide for paying salaries and wages of principal workers and assistants, nor for the purchase of capital equipment.

As in past years, the Subcommittee on Grants-In-Aid will use the survey *Research Needs in Petroleum Geology*, Bulletin A.A.P.G., Vol. 41, No. 8, pp. 1854-76, August 1957, as a general guide in making recommendations for support of research projects. Within this framework, the qualifications of the applicant, the probability that his work will contribute to new knowledge of petroleum geology, evidence that he can complete the proposed work, and indication that publication will result for the benefit of petroleum geologists in general, will form the basis for making final awards.

For further information and application forms write *AAPG Headquarters, Box 979, Tulsa 1, Okla., or R. H. Nanz, Chairman, AAPG Grants-in-Aid Subcommittee, Shell Development Co., Box 481, Houston, Tex.*

New Nevada Map Series

A new series of maps showing the locations of various mineral deposits in Nevada has been announced by the Nevada Bureau of Mines. The series forms part of a project designed to provide the public with the latest information on Nevada's vital mineral resources. The new maps are being issued in preliminary form at a scale of 1:1,000,000 to make them immediately available to the mineral industry. In due course descriptive material and reduced copies of the maps will be published for both sale and exchange. Individual preliminary maps are being printed separately by subject to show the distribution of a single metallic or nonmetallic mineral, basic geology, geologic structure lines, intrusive rocks, volcanic rock cover, alluvial cover and other information pertinent to the economic development of Nevada.

Information on these preliminary maps may be obtained from the *Nevada Bureau of Mines, University of Nevada, Reno, Nevada.*

Mississippi Geological Society officers recently elected are pictured above from left to right: A. T. Ricci, Jr., Mobil Oil Co., Secretary; L. J. Ringenberg, Lion Oil Co., Vice President; X. M. Frascogna, Consulting Geologist, President; and L. B. Culligan, California Co., Treasurer.

McCaughey Graduate Fellowship in Mineralogy Established at Ohio State

A graduate fellowship in Mineralogy has been established at the Ohio State University in honor of Doctor William J. McCaughey, Professor Emeritus of Mineralogy. Professor McCaughey joined the Ohio State faculty in 1911, and served with distinction until his retirement in 1952. He was the founder and first chairman of the Department of Mineralogy, serving in the latter capacity from 1916 until 1952.

Professor McCaughey enjoys the distinction of having taught the first formal course in this country in silicate phase equilibrium. He was thus one of the first educators to recognize the great value of thermochemical mineralogy in both geological and technological research.

The new fellowship has been made possible through the joint sponsorship of the AC Spark Plug Division of General Motors Corporation, Basic Incorporated, the Edward Orton, Jr. Ceramic Foundation, the Harbison-Walker Refractories Company, and the Owens-Corning Fiberglas Corporation.

The first recipient of the William J. McCaughey Fellowship in Mineralogy is Mr. Thomas John Rockett, a candidate for the Ph.D. degree, who is pursuing research in thermochemical mineralogy. Mr. Rockett holds a B.S. degree in geology from Tufts University, and an M.S. degree in geophysics from Boston College.

SOVIET RESOURCES

(Continued from page 18)

In fact the explored and geological reserves of oil and gas in the Soviet Union fully justify the priority given to the production of these two economical fuels which are at the same time very valuable raw materials for the chemical industry. Therefore the task facing geologists today is to find major high-yield deposits which would enable oil and gas output to be raised to the desired level with the least possible number of wells drilled and, consequently, with the least amount of money and effort spent.

Another line of attack is to increase oil output at the existing fields by improving production methods. At present not more than 40 per cent of oil at a deposit is recovered, the rest is lost in rock.

As has already been noted elsewhere, the share of coal in the country's fuel supply is planned to be markedly reduced. However, coal will remain essential as a source of power, as a process fuel, and as raw material for the chemical industry. The Soviet Union has reserves of coal, exceeding 8.6 trillion tons, or more than the rest of the world. Incidentally, the reserves of the Donets coal fields, in spite of many years of intensive exploitation, are put at more than 240 billion tons, or more than the explored reserves in czarist Russia.

The target for 1965 is to produce 612 million tons of coal, while the capacity of explored stand-by districts alone is 750 million tons. A large number from among the latter have been found suitable for open-pit working and are estimated at about 250 million tons. The bulk of these reserves is found in the eastern part of the country, thus providing the most favorable conditions there for large thermal power stations to be built with low unit investment costs. The large coal deposits occurring near the surface are grouped in the Kansk-Achinsk, the Minusinsk, the Turgai, the Irkutsk and other coal fields in Eastern Siberia and Kazakhstan.

It should be noted that the aggregate explored reserves of coal are quite sufficient to meet the country's needs. On the other hand, the number of coking coal mines, especially of scarce grades, is insufficient because of serious gaps in comprehensive prospecting for coking coals. The elimination of this bottleneck is therefore our primary task. Of particular importance in this connection is the South Yakutian field of coking coals partially explored in recent years. Commercial development of the field in the very near future will meet the coke requirements of the future iron and steel mills in Eastern Siberia and the Soviet Far East.

The Soviet Union is the world's richest country in explored reserves of iron ores, accounting for about 40 per cent of the world's reserves. Unique both in the quality and quantity of iron ore are deposits in Western Kazakhstan, where a large mining enterprise is under construction with an annual output of 26.5 million tons. Sizable iron-ore deposits have also been found in Central Kazakhstan where a large iron and steel mill is being built equal in importance to the Magnitka Mill in the Urals. However, iron ore deposits are particularly numerous in Siberia. These are the Angara-Pit range in the Krasnoyarsk Area, the Angara-Ilim range of self-fluxing iron ores in the Irkutsk Region, the Berezov range in the Chita Region, the Kimkan and the Garinsk ranges in the Soviet Far East, the Tayezhnoye range in Southern Yakutia, and many others. A powerful field of sedimentary oolitic iron ores tentatively estimated at tens of billions of tons was discovered in the upper Ob Valley (the West Siberian Depression) when prospecting for oil. For the most part, the deposits and ranges opened up in the eastern areas contain ores which do not need development and are suitable for open-pit working.

By far the largest development in iron-ore mining has been the discovery of the world's largest deposits in the Kursk magnetic anomaly. This magnetic anomaly was first observed by Academician P. B. Inohodtsev in 1783. Its close study however was not undertaken until about a hundred years later, in 1874, when the anomaly was rediscovered in the Belgorod area by I. N. Smirnov in the course of a magnetic survey. The hypothesis put forward at the time was that the magnetic anomaly was due to a considerable body of iron ores lying deep in the earth's crust.

The possibility of mining commercial iron ore right in the center of the country appealed to Vladimir I. Lenin, for an iron field situated in a location as economically advantageous as the Kursk Region and close to the Donets coal fields constituted a tremendous economic gain for the Soviet Union. On Lenin's instructions a study was started of the Kursk magnetic anomaly. All the work involved was given an over-riding priority as a project of state importance.

The purposeful and painstaking work had revealed by late 1959 that there were extremely rich iron ores in an area 700 kilometers long and 150-200 kilometers

wide. The new field extends partially into the Kursk, Belgorod, Voronezh, Orel, Bryansk, Kaluga and Kharkov Regions. The total reserves of iron ore in the Kursk magnetic anomaly exceed 30 billion tons. Of this amount, more than 10 billion tons have been found profitable for mining. This is much is excess of all the iron ore reserves in the United States.

Apart from bonanza ores containing 60 to 62 per cent iron, the Kursk magnetic anomaly has practically inexhaustible reserves of leaner iron quartzites. It is truly te world's biggest iron ore field.

The Kursk magnetic anomaly is already producing commercial iron ore. Under the seven-year plan the iron-ore mines to be built there are to produce at least 15 million tons a year. Already by the end of the current year iron ore production will have risen to 7 or 7.5 million tons. It is also contemplated to bring in additional facilities to mine 7 to 9 million tons above the plan.

International Mineralogical Association

The third general meeting of the International Mineralogical Association in Washington, D. C., April 17-20, 1962 was announced recently by Dr. Alvin Van Valkenburg of the National Bureau of Standards and chairman of the local meeting committee.

The program will feature a symposium on the *Mineralogy of Sulphides*, under the chairmanship of Alfred J. Frueh of McGill (Canada) and another on *Layered Intrusives*, under C. E. Tilley of Cambridge (England). The session will be preceded by a northern field trip led by Paul F. Kerr visiting laboratories of the Geology Department and the Lamont Observatory at Columbia University, Paterson, N.J., zeolite localities and the Franklin, N.J., and Cornwall, Pa., mining districts. Following the meeting Richard V. Dietrich will lead a field excursion to various Virginia mineral localities. Following this trip there will be a tour of mineralogical museums in Philadelphia, New York, New Haven and Boston.

The Mineralogical Society of America is arranging for low-cost air charter transportation from London to New York and return.

Details about the meeting and the charter flight may be obtained by writing *Miss Marjorie Hooker, U. S. Geological Survey, Washington 25, D. C.*

Geological Age Determinations...

(by the K-Ar Method)

. . . routinely available in 30 days. A new geological tool, of wide practical value. Useful in oil and mineral exploration, as well as survey programs.

For details, write Department H, for our pamphlet, *Potassium-Argon Age Determinations.*

Geochron Laboratories, Inc.

24 Blackstone Street • Cambridge 39, Mass.

DEPTH PROTECTION

PROTECT VALUABLE STRATA-DATA

put your samples in

HUBCO PROTEXO BAGS

with the exclusive GOLDEN "Magic-Mark" Tag!

For positive identification . . . outstanding strength insist on Hubco Protexo Sample Bags!

The tag can be read indefinitely. Ordinary pencil markings stay on even though soaked in water, oil, or encrusted with mud. Waterproof . . . insect proof and mildew proof!

The bag is super strong. Finely woven to prevent sifting, yet permit drainage.

Ask for the Bag with the Golden Tag!

IN SPECIAL HANDY-PAK DISPENSER CARTONS

Packed in 100's for easy storage, convenience, and less waste!

H2-661

Buy HUBCO BAGS at your favorite supply store or write

HUTCHINSON BAG CORP.

P. O. BOX 868-G HUTCHINSON, KANSAS

TAX PROTECTED INCOME AND CAPITAL FROM OIL AND GAS INVESTMENTS, *1959, 177 pp., Business Reports Inc., Larchmont, N.Y., $12.50.*

A comprehensive tax guide for persons with investment in oil and gas.

ALETSCHGLETSCHER, *Sheet No. 3, 1960, 1:10000, Topographical Survey of Switzerland, Seftigenstrasse 264, Wabern-Bern, 10 Swiss Francs.*

A very interesting topo map, part of a new series which affords the opportunity to study in detail the Great Aletsch Glacier, longest, largest, and one of the most-studied in the Alps.

DESCRIPTIVE PALAEOCLIMATOLOGY, *Edited by A. E. M. Nairn, 1961, 380 pp., Interscience Publishers Ltd., 250 Fifth Ave., New York 1, N.Y. $11.00.*

An assemblage of papers by 15 recognized scientists pools a significant amount of information about climates in the geologic past. Many thought-provoking views are put forward.

HISTORY OF THE EARTH, *by Bernard Kummel, 1961, 610 pp., W. H. Freeman & Co., 660 Market St., San Francisco 4, Calif. $8.75.*

An introductory text in historical geology designed to establish the framework for adaptation to class room lectures at the beginning level.

FRACTURE SYSTEMS AND TECTONIC ELEMENTS OF THE COLORADO PLATEAU, *by V. C. Kelley and N. James Clinton, 1960, 104 pp., plus maps, Univ. of N.M. Pubs. in Geol. No. 6, Univ. of New Mexico Press, Albuquerque. $2.75.*

THREE STUDIES IN MINERAL ECONOMICS, *by O. C. Herfindahl, 1961, 63 pp., Resources for the Future Inc., 1775 Massachusetts Ave., N.W., Washington 6, D.C. $1.00.*

Topics are: What is conservation? The Long-Run Cost of Minerals? U. S. Trade Policy for Minerals?

GENERALIZED COMPOSITE STRATIGRAPHIC SECTIONS OF WESTERN COLORADO, *12 pages, 1960, Department of Publications, Colorado School of Mines, Golden, Colorado. $1.50.*

A series of stratigraphic sections for Colorado, west from the Front Range.

DOKLADY

OF THE ACADEMY OF SCIENCES OF THE U.S.S.R., EARTH SCIENCE SECTIONS

- GEOLOGY
- GEOCHEMISTRY
- GEOPHYSICS
- HYDROGEOLOGY
- MINERALOGY
- PALEONTOLOGY
- PETROGRAPHY

COORDINATION — COOPERATION · AGI · SERVICE

Available now . . . 1959 Volumes (124-129)
1960 Volumes (130-135) 133 ready for July

SPECIAL OFFER

Limited copies of Doklady Index (Vol. 124-129, 1959) available, containing complete table of contents and author index. Send 50¢ to cover postage and handling.

Send subscriptions or RENEWALS to:

AMERICAN GEOLOGICAL INSTITUTE
2101 Constitution Avenue, N.W. • Washington 25, D. C.

Payment must accompany order

Subscription Rates to members of AGI Member Societies on GeoTimes mailing list, educational institutions and their personnel $27.00
All others $45.00

Foreign Postage $1.25 per year except PUAS countries .75¢. Canada and Mexico no additional charge.

ULTRAVIOLET GUIDE TO MINERALS, *by Sterling Gleason, 1960, 250 pp., D. Van Nostrand Company, Inc., Princeton, N.J. $6.95.*

Text devoted to fluorescent minerals includes a series of helpful identification tables and contains 16 color plates illustrating fluorescent minerals.

GEOLOGY: *College Outline Series, 1960, 260 pp., Barnes and Noble, New York. $1.75.*

A condensed outline of the principles of physical and historical geology with examination and answers keyed to standard textbooks.

MEASUREMENTS FOR ENGINEERING AND OTHER SURVEYS, *by M. V. Smirnoff, 1961, 556 pp., Prentice-Hall, Inc., Englewood Cliffs, N.J. $9.75.*

This book summarizes various mapping data which will be of assistance to those engaged in surveys in connection with mineral exploration and development, topographic mapping, etc.

EXPLORATION FOR NON-FERROUS METALS, AN ECONOMIC ANALYSIS, *by Lee E. Preston, 1960, 212 pages, Resources for the Future, 1775 Massachusetts Ave., Washington 6, D.C. $2.00.*

Considers various economic factors to be evaluted in the exploration for non-ferrous metals.

PROCEEDINGS OF THE SIXTH MUSKEG RESEARCH CONFERENCE (1960), *155 pp., 1961, Technical Memorandum 67, National Research Council of Canada, Associate Committee on Soil & Snow Mechanics, Ottawa.*

Reporting on the papers and discussions presented in the five technical sessions of the April 1960 conference.

PRICE LIST OF MAPS AND PUBLICATIONS, *April 1961, 11 pp., Kentucky Geological Survey, 307 Mineral Industries Building, Lexington, Ky.*

Public Education is geology's best public relations tool

Russian Book Translations

CONTEMPORARY SEDIMENTS OF THE CASPIAN SEA, edited by M. V. Klenova, 1956, 303 pp., Academy of Science, U. S. S. R., Moscow.

A complete, partially edited, English translation of text and tables available at cost of reproduction (complete translation only) on:

Microfilm 35 mm	$ 17.50
Microcard	$ 4.75
Xerox copies* with cover and plastic binder ...	$100.00

STUDY OF FACIES, by D. V. Nalivkin, 1956, 2 vols., 926 pp., Academy of Science, U. S. S. R., Moscow.

A complete, unedited, English translation of text and tables available for cost of reproduction (complete translation only) on:

Microfilm 35 mm	$ 24.00
Microcard	$ 12.75
Xerox copies* with cover and plastic binder ...	$250.00

*Xerox copies of specific sections of the translation may be purchased for $0.15 per translation manuscript page. The translated table of contents will be supplied upon request.

AMERICAN GEOLOGICAL INSTITUTE
2101 Constitution Avenue • Washington 25, D. C.

Order today

GLOSSARY of GEOLOGY
and Related Sciences WITH SUPPLEMENT

Supplement prepared by
AGI GLOSSARY REVIEW COMMITTEE
J. Marvin Weller, *Chairman*

PART I: Original Glossary of Geology (about 14,000 terms, J. V. Howell, editor, 1957) with special marginal keys which indicate redefined terms and new terms listed in the accompanying Supplement (Part II).

Part II: Supplement of nearly 4,000 new and redefined terms, prepared by the AGI Glossary Review Committee.

Cloth bound, 397 pages

PRICE SCHEDULE

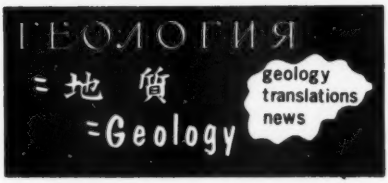
Non-member ---------- $7.50
Members—AGI Member Societies on GeoTimes Mailing List ---------- $6.75†
† Designate your AGI Member Society.

Add $0.25 for Shipment Outside North America

Send payment with order

AMERICAN GEOLOGICAL INSTITUTE
2101 Constitution Ave.
Washington 25, D. C.

Supplement only . . .
SUPPLEMENT TO GLOSSARY OF GEOLOGY
Part II of above only; about 4000 terms, 90 pages, paper bound.
Non-members ---------- $2.50
Member of AGI Member Societies on GeoTimes list ------ $2.00
Add $0.10 for shipment outside North America



Two new means of making Russian geologic information available in English are under way. With the support of a grant from the National Science Foundation to Columbia University, summaries of all papers in the journal *Geologiya Rudnykh Mestorozhdenii* (Geology of Ore Deposits) are prepared by Eugene A. Alexandrov. The reviews are published in *Economic Geology;* the first ones appeared in the January-February 1961 issue.

Another approach is being tried by AGI in its new program which provides complete translation coverage of *Sovetskaya Geologiya* (Soviet Geology). Beginning with the January 1960 issue, this journal is to be translated cover-to-cover. The manuscript translations are reviewed by a group of Virginia Polytechnic Institute geologists, under the direction of Byron N. Cooper, and the reviewers will select the most significant quarter or third of the papers for publication in *International Geology Review.* The table of contents of each issue will be listed in IGR and those papers not selected for printing in full in IGR will be listed by title and author, with pertinent reviewer's comments. These unpublished translations will be made available at cost of reproduction by the AGI Translations Office. Six issues of the 1960 volume have been translated and are being reviewed. The first selections from *Sovetskaya Geologiya* will appear in an early fall issue of IGR and will continue on a regular schedule thereafter.

At the present time the following translation journals carry material pertinent to the earth sciences.

COVER-TO-COVER TRANSLATIONS

- *Bull. Acad. Sci. USSR, Geophys. Ser.* (AGU)
- *Bull. Acad. Sci. USSR, Geol. Ser.* (AGI)
- *Dokl. Acad. Sci. USSR, Earth Sci. Secs.* (AGI)
- *Geochemistry (Geochem. Soc.)*
- *Geodesy and Cartography* (AGU)
- *Geology of Ore Deposits* (SEG)
- *Petroleum Geology* (Rev. of Russian Geol.)
- *Soviet Geology* (AGI)
- *Soviet Physics: Crystallography* (AIP)
- *Soviet Soil Science* (Am. Inst. Biol. Sci.)

Graduate Theses Catalogued in Nevada

The Nevada Bureau of Mines, University of Nevada, has initiated a project to assemble completed graduate theses pertaining to the geology and mineral resources of Nevada.

The project will make available in one central repository valuable research material which might otherwise remain scattered, unindexed, or unknown. The collection will be placed in the Mackay School of Mines Library, University of Nevada, for consultation and study by individuals, industry, government agencies, and other universities.

Accompanying a comprehensive thesis list will be an index map showing the status of geological thesis work in the State. With this information the Nevada Bureau of Mines can assist students and their advisors from universities throughout the country in selecting new thesis areas in which there is no study conflict. The Bureau will also be in a position to serve as liaison between individuals or groups interested in specific areas.

Authors are invited to send copies of their texts, maps, and illustrations to the Nevada Bureau of Mines for inclusion in the project. If copies are not available for permanent deposit, microfilming or duplicating the material by other means may be arranged.

The cooperation of present and future writers on the geology and mineral resources of Nevada will be sincerely welcomed.

Please address communications to the *Nevada Bureau of Mines, University of Nevada, Reno.*

TRANSLATIONS NEWS —*Continued*

SELECTIVE OR PARTIALLY GEOLOGIC

- *Atomic Energy* (Consultants Bur.)
- *International Geology Review* (AGI)
- *Soviet Geography: Review and Translation* (Am. Geogr. Soc.)
- *Problems of the North* (N.R.C. Canada)

The AGI Translations Pool has begun to receive contributions for indexing, publicizing, and distribution. At a recent meeting of editors of translations journals supported by the National Science Foundation, all scientists were urged to share available translations to reduce research costs and time. Send your copies to: *AGI Translations Office, American Geologic Institute, 2101 Constitution Ave., N.W., Washington 25, D. C.*

Announcing . . .

VOLUME 1960

ИЗВЕСТИЯ
АКАДЕМИИ НАУК СССР
СЕРИЯ ГЕОЛОГИЧЕСКАЯ

covering articles on Russian research in the fields of:

Stratigraphy - Tectonics
Mineralogy - Petrology
Economic Geology
History of Geology

IZVESTIYA

OF THE
ACADEMY OF SCIENCES
OF THE U.S.S.R.
GEOLOGIC SERIES

is a cover-to-cover English translation of basic geological research in the Soviet Union.

Subscription Rate

Members of AGI Member Societies on GEOTIMES mailing list (pledge card required), educational institutions and their personnel $27 per year.

Non-members and all others $45.00 per year

Foreign Postage

No additional charge to Canada and Mexico.

Pan American Union countries add 50 cents per year.

All other foreign countries add $1.00 per year.

Send subscription to—

American Geological Institute
2101 Constitution Ave., N. W.
Washington 25, D. C.

Payment must accompany order

TRANSLATIONS WANTED
FOR
AGI TRANSLATION POOL

Do you have any geological translations from Russian, Chinese, or other difficult languages gathering dust in your files?

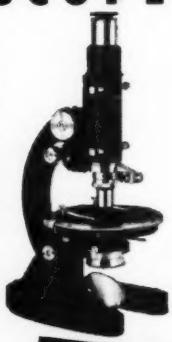
If so, the AGI Translation Office would like to receive them. They will be indexed, publicized and made available to interested scientists at cost of photocopying. We will return a copy of any translation submitted to the translations pool. Send to:

AGI TRANSLATIONS OFFICE
AMERICAN GEOLOGICAL INSTITUTE
2101 CONSTITUTION AVE., N.W.
WASHINGTON 25, D.C.

Try UNITRON'S new
POLARIZING
MICROSCOPE

The Model MPS is a precision instrument designed to meet the exacting requirements of science, education and industry. Ideal for work in chemistry, crystallography, biology, as well as the technology of paper, glass, textiles and petroleum.

- Eyepieces: 5X (micro.), 10X (cross.)
- Objectives: 4X, 10X, 40X, achromatic, strain-free, centerable
- Nosepiece: quick-change type
- Substage condenser: focusable, 3-lens, swing-out top mount, iris diaphragm
- Polaroid polarizer: rotatable 360°
- Polaroid analyzer: in sliding mount
- Bertrand lens: centerable
- Stage: 115mm diameter, revolves 360°, reads to 6' with vernier
- 2 Compensators: quarter-wave plate and first order red plate
- Focusing: both coarse and fine



FREE TEN-DAY TRIAL

Quantity prices on three or more

Accessory mechanical stage $14.75

$269
fob Boston

UNITRON
INSTRUMENT COMPANY • MICROSCOPE SALES DIV.
66 NEEDHAM ST., NEWTON HIGHLANDS 61, MASS.

Please rush to me, UNITRON's Microscope Catalog. 18-T
Name_____
Company_____
Street_____
City_____ State_____

Penn State Geophysicists have designed the 26-inch plastic disc pictured here to simulate the earth for use in elastic wave experiments directed toward seeking improved methods of detecting underground nuclear blasts. The project, carried out under a grant from the Air Research and Development Command, U.S.A.F., is under the direction of Dr. B. F. Howell, Jr. assisted by **Peter M. Lavin** (in photo above) and John Peluke.

Texas-Mexico Cooperative

The Department of Geology and Bureau of Economic Geology of The University of Texas and the Instituto de Geología of La Universidad Nacional Autonoma de Mexico have recently signed a cooperative agreement for geologic research in Mexico. Graduate students at The University of Texas of both United States and Mexican citizenship will undertake research problems in Mexico. The Instituto de Geología will designate problem areas, cooperate in supervision, furnish field assistance, materials and supplies, help to defray field expenses, and provide a Spanish language vehicle for publication. In addition, the Instituto will recommend Mexican candidates for graduate study at the University of Texas and assist in financing their graduate studies. The Department of Geology and Bureau of Economic Geology will direct the geologic research in Mexico, supervise the field work and provide financial assistance for Mexican graduate students through scholarships, fellowships, and assistantships.

Field parties working under this cooperative agreement are already in Mexico. The first Mexican student to pursue graduate work under this program will arrive at The University of Texas in September.

CLASSIFIED ADS . . .

Rates per line per insertion				
No. of times	1	2	4	8
POSITIONS WANTED	$0.50	$0.30		
VACANCIES	1.50	1.00		
SERVICES-SUPPLIES	2.25	1.50		
CONSULTANTS	2.25	1.50		
ONE INCH BOX	25.00	22.50	21.25	20.00

No discounts. AGI Box Number $2.00 extra. Minimum charge $2.00. All classified advertisers will be billed, *do not send advance payment.*

Address all inquiries to:

Box .....
c/o American Geological Institute
2101 Constitution Avenue, N.W.
Washington 25, D.C.

MICROPALAEONTOLOGIST
HYDROGEOLOGIST

GEOLOGICAL SURVEY OF CANADA
Department of Mines and Technical Surveys

One Geologist with a Master's or Ph.D. degree specializing in Mesozoic and Cenozoic microfossils, particularly foraminifera of Western Canada. SALARY—$7140-$9940. Competition Number 61-1902.

One Ph.D. Hydrogeologist to conduct ground-water studies anywhere in Canada. SALARY — $7140-$9800. Competition Number 61-1901.

Write for details and application forms to the CIVIL SERVICE COMMISSION, OTTAWA, ONTARIO, CANADA quoting the Competition Number indicated above.

VACANCIES

FIELD GEOLOGIST for examination and evaluation of mineral deposits in low latitude desert, Middle East. College graduate in economic geology and five years experience including use of aerial photographs. Submit evidence of training and experience with salary expected to Box 134.

MINERALOGIST-PETROGRAPHER with knowledge and experience in the use of advanced optical principles and techniques. Research to develop methods for evaluating the physical properties of carbon substances. Large research laboratory Pittsburgh area. Submit resume and salary requirements to Box 135.

SEDIMENTARY PETROLOGIST and sedimentologist, Ph.D. or equivalent, for September 1961, to teach advanced courses, organize research program on recent sediments of Gulf Coast, and sometimes lecture introductory courses. Salary and rank depend upon qualifications. Send resume to: Department of Geology, University of Houston, Houston 4, Texas.

PETROGRAPHER-MINERALOGIST — sound microscope training, strong chemical background and interest required. Industrial research laboratory, high temperature materials. Submit resume including academic transcripts. Box 136.

IMMEDIATE OPENING in modern research center for specialist in petrography and x-ray diffraction methods. A leading refractory manufacturer, located in the mid-west. Many employee benefits. Salary open. Send resume to Box 137.

STATISTICAL ENGINEER. Geoscientist with academic background in mathematical statistics for the position of statistical engineer with exploration company. Location: western United States. At least two years of mineral exploration experience and one additional year experience in the application of statistical analysis and/or operations research techniques to exploration problems preferred. Salary commensurate with experience and ability. Please send resume of experience and training and salary requirements to Box 138.

POSITIONS WANTED

BOX 768. GEOLOGIST-MINERALOGIST, Ph.D., 31, family. Three years experience in major oil company research laboratory in fields of X-ray and fluorescence analysis, clay mineralogy and geochemistry of sediments. Broad graduate background in geology. Desires position at college or university. Available immediately.

BOX 774. GROUND WATER GEOLOGIST-HYDROLOGIST, 40, family. 1 year post graduate work. Five years experience with USGS, five years consulting. Geohydrology and engineering background with experience throughout U. S. Interested in position of responsibility. Open to foreign work. Resume on request.

BOX 835. GEOLOGIST, Ph.D. summer 1961, 30, family. Background (western U.S.) includes four-years mineral exploration and evaluation (metals, non-metals), two years stratigraphic research. Outstanding industrial references and academic record. Interested in economic applications of geology including petroleum. Opportunity of prime concern, salary secondary. Resumé.

BOX 838. GEOLOGIST, Ph.D. June 1961, M.A. in Geology, M.A. in Geography, 5 yrs. teaching experience as Ass't Prof. of Geology, Field experience with A.E.C., desires teaching position. Avail. Sept.

BOX 839. GEOLOGIST, Ph.D. with broad teaching background desires teaching position or museum work. Principal fields taught: structural geology, petrology, mineralogy, geomorphology, paleontology, economic geology. Can teach other geological fields and biology.

ENGINEERING GEOLOGIST, 30, 4 yrs. progressive experience with U. S. G. S., 2 yrs. experience in seismic & magnetic prospecting, 1 yr. of graduate school. Publications in ground water, Pleistocene geology, geophysics & drilling contract administration. Have partially supervised 15,000 feet of rotary & cable-tool deep water well drilling & hole sitting. Familiar with deep lift pumps. Available on short notice. Salary not of main consideration, desire more responsibility & varied experience, particularly in work dealing with people. Will consider short term assignment. Family. 722 N. Tonopah Dr., Las Vegas, Nevada.

BOX 842. ECONOMIC GEOLOGIST-GEOCHEMIST, Ph.D., 32, family, 7 yrs. experience all phases exploration, primarily metallic ores; at present NSF Postdoctoral Fellow. Desires stable position in exploration or geochemical research, preferably on ore genesis. Will consider teaching position with time for research. Resume on request. Available December, 1961 or March, 1962.

BOX 843. GEOLOGIST, Ph.D., 32. Desires responsible overseas position with aggressive engineering firm, minerals exploration, or petroleum exploration company. Polyfluent: Spanish, French, Portuguese. Six yrs. diversified surveys & petroleum exploration experience domestic, Australia, & Africa; also in geophysics, principally seismic. Specialties: field mapping, stratigraphy, geophysical interpretation, petroleum exploration, photogeology. Available October 1. Resume on request.

BOX 844. PRODUCTION GEOLOGIST, M.Sc., 35, family, broad graduate background in geology, 10 yrs. experience with major oil company. 3½ yrs. specialization in unitization, joint interest operations, & equity studies. Well versed in general sub-surface operations; mapping, and reserve estimates. Fair knowledge of log analysis, & reservoir engineering principles. Employed in South America for 7 yrs. Nearly bilingual. Will consider relocation in any of 50 states.

BOX 848. GEOLOGIST, 28; Family; 7 yrs. college; 3 yrs. in laterite—bauxite exploration in Africa and Central America; summers experience with Canadian Geological Survey and major oil company; presently working on Pleistocene problems; 2 summers field courses; minors in physics, chemistry, mathematics and 4½ yrs. Russian language; Speak Spanish. Seeks permanent employment either domestic or foreign; references and resume available; availability for work—immediate.

BOX 849. GEOLOGIST, M.S., 28, family, desires responsible industrial or teaching position. Currently engineering geologist; experience also in metallic minerals exploration, photogrammetry, teaching. Available one month's notice. Resume on request.

BOX 850. GEOLOGIST-PALEONTOLOGIST, 29, M.A., Ph.D. Sept. 1961, desires academic position in university or industry with opportunity for research. Principal interests: micropaleontology, stratigraphy, paleoecology, petroleum and field geology. Two years experience with major oil company. Publications.

BOX 854. GEOLOGIST, Ph.D., Swiss, 42, family. Large experience of general prospecting (gold, tin, tungsten, beryllium, columbite, pyrochlore, etc.), alluvial and lode deposits, surface and underground, evaluations. Experience in geochemical prospecting (heavy metals, tungsten, niobium, etc.). Since 1948 in former Belgian Congo with major mining company, in charge of prospecting department. Teaching experience. Desires to change. Anywhere (preference for Africa including former Belgian Congo). On leave in Europe between September and December. Best references. Languages: German, French, English, Italian, Swahili.

BOX 855. GEOLOGIST, M.S., 35, married, 8 yrs. experience Petroleum and General Geology, with Subsurface, Field, and Wellsite work included, in large American Co., 4 yrs. in Ecuador, S.A., seeks domestic employment as Petroleum Geologist or Engineering Geologist. Will consider foreign position. Good references, resume on request.

BOX 856. PALEONTOLOGIST, B.S., M.A., 33, family, veteran. 6 yrs. commercial experience: 4 palynology (Colombia), 2 Foraminifera (California), 2 Paleozoic invertebrates. Presently employed, available Nov. 1.

BOX 857. GEOLOGIST, 40, B.S., 10 years diversified background in all phases of exploration in the Four Corners and West Texas. Desires more responsibility. Capable of managing exploratory program.

BOX 858. GEOLOGIST, 27, M.S., 2½ years experience in industrial mineral exploration and development. Currently employed. Desires responsible position with aggressive mining firm in western U.S.

CONSULTANTS

J. W. SCHROEDER, PETROLEUM GEOLOGIST, P. O. Box 298, Cornavin, Geneva, Switzerland.

LOUIS DESJARDINS, Photogeological Services. 909 Kennedy Bldg., Tulsa, Okla. Foreign & domestic. Specialist 25 yrs. experience.

RICHARD SPENCE TAYLOR, Ph.D., P. Geol. (Alta.) Economic & Pleistocene geology, & Photogeology. 301 Noble Bldg., Edmonton, Alta., Canada.

SERVICES & SUPPLIES

SOVIET GEOLOGICAL MAPS. Send for a list. Telberg Book Co., 544 Sixth Avenue, N. Y.

FOSSILS for study, research, display. Bulk microfossils, laboratory specimens. Geological Enterprises, Box 926, Ardmore, Oklahoma.

"THE MINERALOGIST" is a magazine for the serious mineral collector and amateur mineralogist. Bimonthly, only $2.00 per year. Sample 25¢. Mineralogist, Box 808, Mentone, Calif.

FOSSIL INVENTORY now shows over 700 species for sale. Free list available. Excellent source for collectors, museums, classroom material. Malicks, 5514 Plymouth Road, Baltimore 14, Maryland.

ROCK CHIPS

by SANDSTONE SAM

Nitrate: Lower price after six.

★ ★ ★

Authors Note: A short pencil is better than a long memory.

★ ★ ★

If you find life empty, try putting some life in it.

★ ★ ★

Then there was the structural geologist's wife who insisted on soaking the *diapir* in the *basin*.

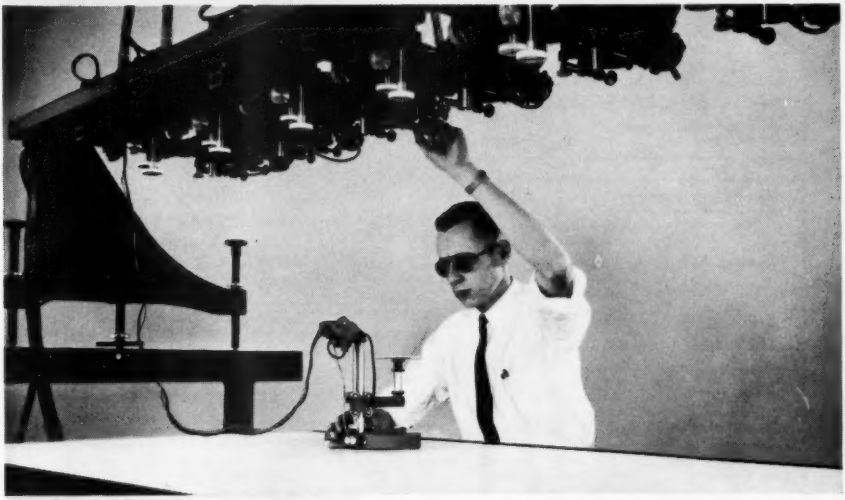
★ ★ ★

ETYMOLOGICAL ABSURDITIES

Noun	*Adjective*	
	Classic	*Modern*
Stone	Stony	Stonular
Rock	Rocky	Rockular
Nut	Nutty	Nutular
Bug	Buggy	Bugular
Vug	Vuggy	Vugular
Pith	Pithy	Pithular

American Air Surveys
Aerial Mapping Company of Idaho
Land & Air Maps Incorporated
Spencer B. Gross
Photogrammetry Incorporated
Albert C. Jones Engineering Co.
Lewis-Dickerson Associates
Engineering Services, Inc.
Mark Hurd Aerial Surveys
L. Robert Kimball
Affiliated Alaskan Architects, Engineers, Surveyors
Carl M. Berry
Cartographers, Incorporated

Why do they all map with BALPLEX?



Sun Ray Mid-Continent Oil Co.
Lester E. Swain
Interstate Mapping Co.
K. B. Wood & Associates
Falcon Air Maps
Librascope
Intex Oil Company
Keystone Mapping Company
Engineering Service
Michael Baker Jr., Inc.
Allen G. Butler
Skylens, Incorporated
J. R. Simplot Company
Clair A. Hill & Associates
Aerial Mapping Corporation
Robinson Aerial Surveys Inc.
Boothe Company Incorporated
Somerset Aerial Surveys Inc.
Autometric Corporation
Erdman, Anthony & Hosley
Alster & Associates
Colorado School of Mines
Syracuse University
Virginia Military Institute
Cornell University
Massachusetts Institute of Technology
University of Colorado
Oregon State College
Georgia Institute of Technology
Griffiss Air Force Base
U. S. Navy Hydrographic Office
U.S.G.S.
Corps of Engineers
Washington State Highway Commission
Bonneville Power Administration
Idaho State Highway Dept.
U.S.N.P.I.C.
A.C.I.C.

Because Balplex is both a bridging and a compilation instrument. It plots contours from aerial photographs with high precision (grid accuracy of +1/10,000) . . . high magnification (5X) . . . *needs no calibration* . . . yet costs hundreds of dollars less than any other dependable plotter!

BAUSCH & LOMB SINCE B&L 1853

Made in America, to the world's highest standards.

BAUSCH & LOMB INCORPORATED
89619 Bausch Street, Rochester 2, N. Y.

Please send me catalog F-310 with data on Balplex aerial mapping equipment.

NAME .....

PROFESSIONAL ADDRESS .....

.....

.....

SERVICES & SUPPLIES

GEOLOGICAL AGE DETERMINATIONS

Potassium-Argon Age Determinations now routinely available in 30 days.
Write for illustrated pamphlet, Department H.

GEOCHRON LABORATORIES, INC.
24 Blackstone Street
Cambridge 39, Mass.

GEOPHYSICAL SURVEYS
LAND or UNDERWATER DETAIL or RECONNAISSANCE
for
FOUNDATIONS
GROUND WATER
SITE INVESTIGATION

WESTON GEOPHYSICAL ENGRS INC
PO BOX 306 WESTON 93, MASS

For Microscopists

Index of Refraction Liquids
207 Liquids. Range 1.35 to 2.11 Index

Allen Reference Sets
Provide Authentic Unknowns for reference in microscopical work. Write for details

R. P. CARGILLE LABORATORIES, INC.
117 Liberty St. New York 6, N. Y.

Chemists for the Industry
ANDREW S. McCREATH & SON, INC.
Analytical Chemistry — Spectrography
X-ray Diffraction — Cargo Sampling
Coal Analysis — Physical Testing
Differential Thermal Analysis
236 Liberty Street, Harrisburg, Pa., U.S.A.

QUALITY LEATHER FIELD EQUIPMENT
Geology Field Cases, Hammer Holsters, Pocket Transit Cases, Special Equip. Custom Made. Geology School & Group Accounts Invited. Write for Folder.

ROY GFELLER
Big Timber, Mont.
Maker of Utility Equipment for the Geologist

THIN SECTIONS
Petrographic thin sections made from your cores, core chips or sedimentary or metamorphic outcrop samples. Careful attention to individual orders. Quality workmanship. Satisfaction guaranteed. Reasonable prices. Price list on request.

CAL-BREA, P. O. Box 254
BREA, CALIF.

MAGNETOMETERS
Vertical Force
SALES • RENTALS • REPAIRS
GEOPHYSICAL INSTRUMENT & SUPPLY CO.
1616 BROADWAY, DENVER 2, COLO.
TAbor 5-8914 A. A. DANISH, Mgr.

TRITIUM MEASUREMENT IN NATURAL WATERS

now offered for meteorologists, oceanographers and hydrologists

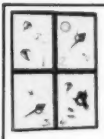
ISOTOPES, INC.
123 Woodland Ave.
Westwood, N. J.

RADIO CARBON DATING

. . . now offered as a standard service at reasonable cost

ISOTOPES, INC.
123 Woodland Ave.
Westwood, N. J.

FOR SALE
Earth Resistivity Equipment
Georator—Gish Rooney Type
COMPLETE—NEAR NEW
Box S-8 AGI



• 9"x12"-X-RAY PHOTO SILHOUETTES OF SHELLS: Each, $1.50 - 4 for $5.00
• RUSSIAN ATLAS for interpretation of magnetic & gravitational anomalies, 130 (8½x10") curves & illustrations. Set - $26.00. English text, $5.00

SEND CHECK OR MONEY ORDER TO
GEO - LINGO - SERVICE
P.O. Box 5626 Oildale California

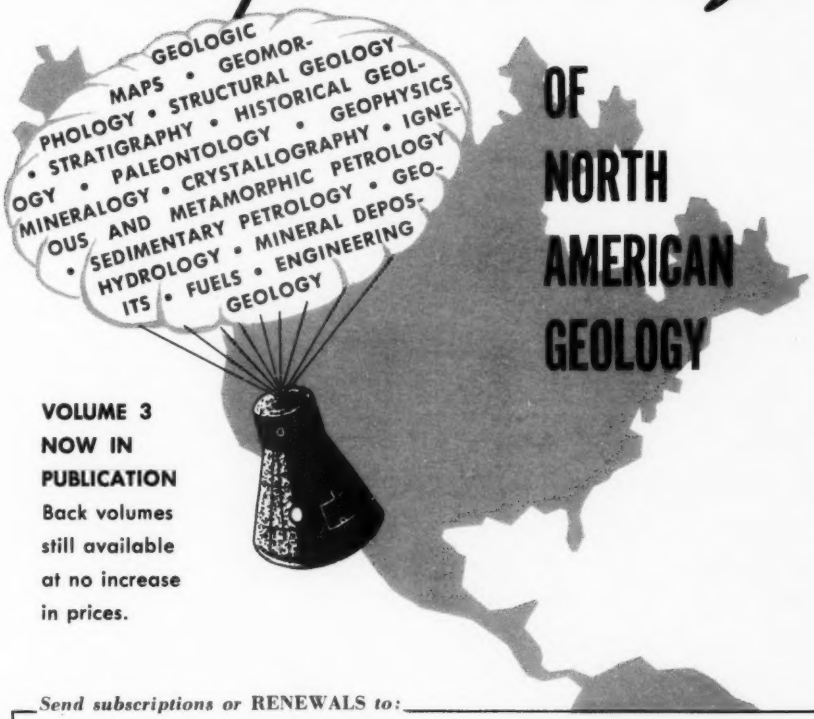
Answer to GEOLOGIC QUIZ

Vicinity of Mount Rainier. From the new Geologic Map of Washington, obtainable from Washington Division of Mines and Geology. Olympia, Washington.

Abstracts
of
GEOLOGIC MAPS AND GUIDEBOOKS
should be submitted to
GEOSCIENCE ABSTRACTS
American Geological Institute
2101 Constitution Ave., N.W.
Washington 25, D. C.

GEOSCIENCE ABSTRACTS

PROVIDES *Capsule Coverage*


GEOLOGIC MAPS • GEOMORPHOLOGY • STRUCTURAL GEOLOGY • STRATIGRAPHY • HISTORICAL GEOLOGY • PALEONTOLOGY • GEOPHYSICS MINERALOGY • CRYSTALLOGRAPHY • IGNEOUS AND METAMORPHIC PETROLOGY • SEDIMENTARY PETROLOGY • GEOHYDROLOGY • MINERAL DEPOSITS • FUELS • ENGINEERING GEOLOGY
OF NORTH AMERICAN GEOLOGY

VOLUME 3 NOW IN PUBLICATION

Back volumes still available at no increase in prices.

Send subscriptions or RENEWALS *to:*

AMERICAN GEOLOGICAL INSTITUTE

2101 CONSTITUTION AVENUE • WASHINGTON 25, D. C.

Payment must accompany order

Subscription Rates

To members of AGI Member Societies on GeoTimes mailing list.	**$15.00**
Non-member individuals, public libraries, colleges and universities;	**$35.00**
Private organizations and government agencies	**$65.00**

Foreign Postage

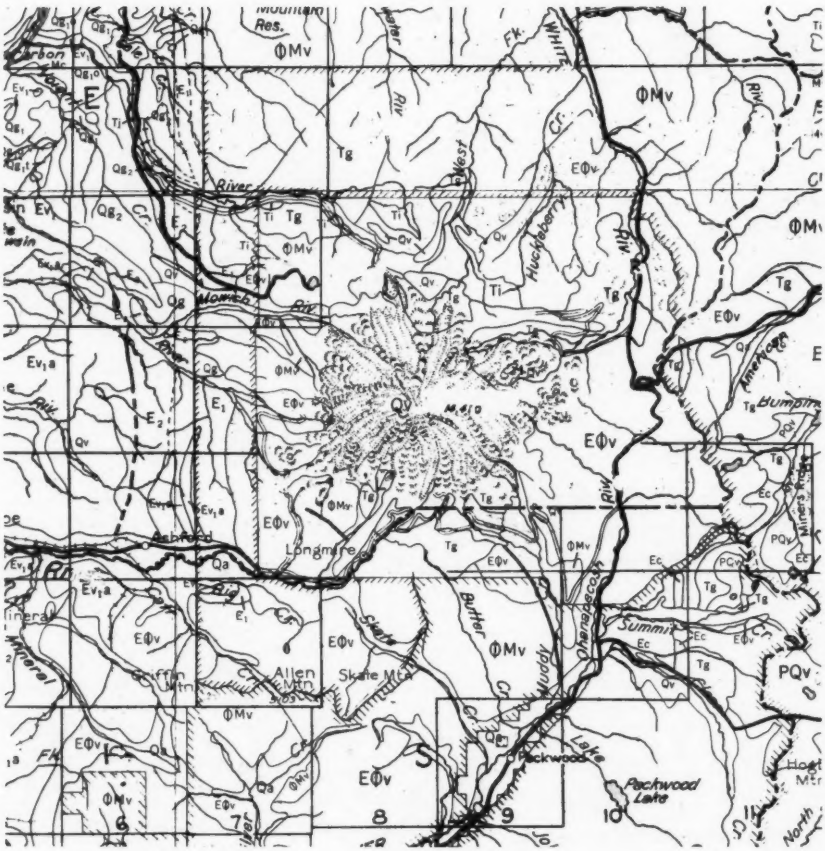
No additional charge to Canada and Mexico

To Pan American Union Countries add 50 cents per year.

To all other foreign countries add $1.00 per year.

GEOLOGIC QUIZ No. 9

Where is it?



Here is a real easy one—

This very prominent mountain of recent volcanic origin should be a dead give away. Scale is 1:500,000 and the answer is on page 52 .

WILLIAMS & HEINTZ MAP CORPORATION

8351 CENTRAL AVENUE, WASHINGTON 27, D. C. REDWOOD 5-4436